Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods **15 May 2013**

Forty-third session
Geneva, 24 – 28 June 2013
Item 2 (b) of the provisional agenda
Explosives and related matters: Review of test series 6

Reporting of Results of Survey on the Test Series 6

Transmitted by the Institute of Makers of Explosives (IME)

Introduction

1. At the thirty-ninth session of the UN TDG Sub-committee (TDG), the TDG working group on explosives (EWG) discussed issues of difficulty in conducting tests outlined in the UN Manual of Tests and Criteria (Test Manual), and recommended to the TDG sub-committee[1] that the EWG conduct a review of the tests mentioned in Parts I and II of the manual with a view to:

a) Better defining the specifications of the tests,
b) Better defining the tolerances associated with those specifications, and
c) To remove any unnecessary or over-specifications.

2. Australia offered to coordinate a survey of experts on the basis of permitted variations to Test Series 8 and IME offered to coordinate the work, along with USA and Canada, on Test Series 6 (TS6).

3. The TDG Sub-committee agreed that this work should be carried out[2].

4. As a first step in the review of TS6, IME, along with USA and Canada, conducted a survey to obtain comments, observations, and experiences in performing TS6. At the forty-first session of the TDG, IME reported initial results of this survey in UN/SCETDG/41/INF.33.

5. The TDG welcomed the report from IME and requested that it expand the distribution of the survey and to report back at its forty-third session.

Discussion

6. The survey was initially distributed to:

a) All participants at the June EWG
b) CERL
c) USA explosives testing & classification laboratories
d) BAM
e) TNO

[1] UN/SCETDG/39/INF.58, para. 13
[2] ST/SG/AC.10/C.3/78, paras. 24 - 25

f) INERIS
g) HSL
h) IME members
i) SAAMI
j) FEEM
k) AEISG
l) US Department of Defense
m) US Department of Energy

7. After the forty-first session, the survey was subsequently distributed to:

a) Participants at the IGUS/EPP 2012 meeting in Berlin
b) Participants at the 2012 meeting of the Chief Inspectors of Explosives in Berlin
c) IGUS/EOS
d) CEFIC
e) ICCA
f) SAFEX

8. In total, thirty-one replies (twenty-two initial replies and nine replies to the second distribution) were received from:

a) National defense ministries
b) National and independent explosives testing laboratories
c) Explosives, fireworks, and automobile supply industry members
d) Explosives and pyrotechnics associations
e) NATO

9. In addition to the thirty-one survey replies, a comprehensive set of comments addressing the subject of improving the test series was received from the Alliance of Special Effects and Pyrotechnic Operators, Inc. (AESPO). The comments contained therein are relevant and bear consideration, but do not fit into the survey format; therefore, it is included for consideration by TDG in Annex 1.

Survey Results

10. **General comments.** The respondents provided numerous comments regarding Test Series 6. Many concerned confusion of:

- the meaning of terms,
- when to use a detonator and when to use an igniter,
- when to use equipment mentioned in test specifications, and
- how to interpret test results.

11. All of the comments have been collected and are reproduced in Annex 2. In this summary document:

- From question-to-question, there is no correlation between the positions of comments. In other words, the first comment in Test 6(a) question 1 may not be from the same respondent as the first comment in question 2.
- The comments are presented in no particular order.
- A tally of responses is included, along with percentages. You will note that not every respondent replied to every question.
- The source of comments is not identified.

12. **Section 16.2.2.** This section describes the order of test performance and the conditions under which tests may be waived. This section does not address the potential

waiver of the 6(a) and 6(b) tests if the 6(d), when required, has been passed. This waiver was discussed by the EWG and endorsed by the TDG at its 35th Session[3]. Additionally, the structure of the section makes it difficult to determine what order changes and/or waivers may be appropriate. Finally, for the 6(a), 6(b) and 6(d) tests, some commenters questioned why the test is required of articles that are shipped without a means for initiation or ignition or otherwise designed such that functioning within the transport package is prevented. This is an issue that has been considered TDG and its EWG, yet the question continues to arise. Currently, no guidance on this topic is provided in the Test Manual and IME believes that it would be helpful to the users if such guidance were provided to help in understanding these tests.

IME recommendations:

a) Section 16.2.2 should be revised to indicate that, if 6(d) is required, it should be performed first.

b) Section 16.2.2 should be revised to indicate that, if 6(d) has been passed, 6(a) and 6(b) may be waived.

c) Section 16.2.2 should be restructured to make its reading and interpretation easier.

d) The sub-committee should consider whether some guidance should be provided, in reference to the 6(a), (b), and (d) tests, to applicability of the tests regardless of whether the products can function in the transport packaging.

13. **Test 6(a)**.

a) **Purpose of the test.** 73% responded that the purpose of the test was adequately defined. Section 16.4.1.1 of the Test Manual clearly states that the purpose of the test is to determine if there is mass explosion of the contents; however, there is some confusion as to the meaning of the term "mass explosion".

Comments indicated that some are unsure if testing explosives shipped singly under Test 6(a) was necessary, since all the contents will explode. This issue is adequately addressed in Section 16.2.2 of the Test Manual, which states that, for articles packaged singly, the 6(a) test can be waived.

IME recommendations:

i) Revise the heading of Section 16.4.1.1 to read "*Purpose*". This revision is also suggested for Sections 16.5.1.1, 16.6.1.1 and 16.7.1.1.

ii) Insert the following sentence at the end of Section 16.4.1.1 of the Test Manual:

> *See Appendix B of the Model Regulations for the definition of "mass explosion".*

iii) Review the definition of "mass explosion" in Appendix B of the Model Regulations to ensure that it is still appropriate and clear in its meaning.

b) **Test materials.** 62% responded that the materials required to perform the test were adequately described. One significant issue that was called to attention was that of the "standard detonator" described in Section 16.4.1.2, which, as several respondents noted, is not available as specified. A quick survey by IME of several test agencies revealed that, when a test specifies use of a "standard

[3] ST/SG/AC.10/C.3/70, para. 18 and UN/SCETDG/35/INF.57, para. 11(a)

detonator", a commercially available detonator believed to provide equivalent results is used. The table in Annex 3 provides specifications of detonators identified to IME as being used in place of the "standard detonator" referred to in the Test Manual.

The list in Section 16.4.1.2 appears to imply that both a detonator and an igniter are required. Based upon the guidance given in Sections 16.4.1.3.2 and 16.4.1.3.3, IME does not believe that this is the case, and that this should be clarified.

Suggestions were received to include more sophisticated means of blast characterization such as the effect of donor action on receptors, projection hazards, etc. IME disagrees with these recommendations as it understands that the 6(a) test is intended to be a relatively basic, simple mechanism for determining if there is a mass explosion hazard. Other blast characteristics are not examined by the 6(a) test.

IME recommendations:

i) The sub-committee should revise Appendix 1 of the Test Manual to specify broader criteria for detonators that can be used as a "standard detonator" pending a more detailed study on more appropriate criteria, and should commence such a study.

ii) Revise the list in Section 16.4.1.2(b) as follows:

(a) A detonator to initiate the substance or article or an igniter just sufficient to ensure ignition of the substance or article (see 16.4.1.3.2 and 16.4.1.3.3);

(b) Suitable confining materials (see 16.4.1.3.4); and

(c) A sheet of 3.0 mm thick mild steel (or equivalent mild steel such as 11 gauge or CR4 grade) to act as a witness plate.

iii) Reword the comment at the end of Section 16.4.1.2 to read as follows:

Note: In some cases, blast measuring equipment may be necessary.

iv) Revisions similar to those in ii) and iii) above should also be made to Sections 16.5.1.2 and 16.7.1.2.

c) **Detonator vs. igniter.** IME asked if it was clear when to use a detonator and when to use an igniter. 68% of the respondents felt that the procedure was clear on this issue. As noted above, IME believes that Section 16.1.4.2 implies that both are required and has provided a recommendation regarding correcting this implication.

d) **The witness plate.** When asked if a tolerance should be provided for the 3.0 mm specification contained in Section 16.4.1.2, 64% of the respondents responded, "no". Since the purpose of this test is to determine if a mass explosion has occurred, it does not appear that the thickness of the witness plate is that significant. However, 3.0 mm thick mild steel may be difficult to obtain in some parts of the world and alternatives should be provided for. IME has suggested a revision above that would address this problem.

The survey also asked if alternative materials for the witness plate should be considered and 79% of the respondents replied, "No". IME agrees with this assessment since the purpose of the test is to determine if there is a mass

explosion hazard. The witness plate serves no other purpose than to provide an indication that a mass explosion may have occurred. Mild steel is inexpensive and readily available throughout the world and specification of alternative materials doesn't seem necessary. It should be noted that the Competent Authority always has the prerogative to substitute materials used in the test if it deems such substitution appropriate.

e) **Test specifications.** 63% of the respondents indicated that the test specifications were adequately defined. Many of the comments received indicate that the respondent may think that there is some other purpose to the 6(a) test other than determining if mass explosion occurs. IME believes that this is adequately addressed in Section 16.4.1.1. Some suggestions that would lead to better clarity were received. For example, in Section 16.4.1.3.2(c), "—" is used to indicate "negative". It was suggested that the use of the minus sign might not be clear to some, especially non-English speaking users. Also, it was also pointed out that the wording Section 16.4.1.3.2(c) is cumbersome and difficult to read.

   IME recommendations:

   i) In 16.4.1.3.2(c), replace occurrences of "—" with "*negative (—)*".

   ii) Review 16.4.1.3.2(c) to try to improve readability and understanding of the section.

f) **Tolerances.** 64% of the respondents indicated that tolerances weren't of particular use in the specification of the 6(a) test. IME's comments regarding tolerances are discussed above.

g) **Over-specifications.** 78% of the respondents replied that there were no over-specifications in the 6(a) test. Most of the comments received in reply to this query have been addressed above.

h) **Acceptance criteria**. It appears that the indicators of mass explosion described in 16.4.1.4 are leading some to conclude that any occurrence of any one of them is a failure. IME believes this is not necessarily true and that (a) - (d) of Section 16.4.1.4 are offered to assist in evaluating whether a mass explosion has occurred. For example, if there is damage to the witness plate, yet the package contained 50 items of which 48 were recovered unexploded, clearly, mass explosion has not occurred. However there is a perception that the damaged witness plate is automatically a failure of the 6(a) test and requires assignment to Division 1.1, even though a mass explosion obviously didn't occur.

   Some comments were received suggesting that package orientation should be varied in each of the three 6(a) trials. Since the purpose of the 6(a) test is to determine if mass explosion occurs, package orientation seems immaterial. Package orientation would be important if examining projection effects, but this is not the purpose of the 6(a) test.

   IME recommendations:

   i) Review the criteria to ensure that they don't conflict with the definition of "mass explosion" provided in Appendix B of the Model Regulations.

   ii) Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

iii) Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

14. **Test 6(b).** Most of the discussion above about Test 6(a) is applicable to Test 6(b) as well. Some comments were received that indicate that some parties think that the 6(b) test is used for purposes other than as stated in Section 16.5.1.1, that is, to determine if there is package-to-package propagation.

IME recommendations:

a) Review the criteria to ensure that they don't conflict with, or lead one away from, the stated purpose of the test, that is to determine if there is package-to-package propagation.

b) Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

c) Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

15. **Test 6(c).**

a) **Purpose of the test.** 90% of the respondents replied that the purpose of the test is adequately defined. Some concern was expressed about the phrase "… or any other dangerous effect …". The concern is that the phrase is ambiguous and could lead to misclassification affected by burning packing material, the fuel itself, etc. Some clarification should be provided. Also, as noted above the heading of this section and comparable sections in 6(b) and 6(d) should be revised to read, "Purpose".

IME recommendations:

i) Revise the heading of Section 16.6.1.1 to read "*Purpose*". This revision is also suggested for Sections 16.4.1.1, 16.5.1.1 and 16.7.1.1.

ii) The EWG should discuss the phrase "… or any other dangerous effect …" to determine what those other dangerous effect might be. It may be appropriate to revise the ending of Section 16.6.1.1 to read something like, "*… or any other explosives-caused dangerous effect when involved in a fire."*

b) **Test materials.** 75% of the respondents agreed that the 6(c) test materials were adequately described. A suggestion was received concerning the mesh size of the metal grid. The feeling was that an inappropriate mesh size could, after packaging begins to burn away, result in tested product falling into the fire rather than remaining on grid thus confusing interpretation of the test. Some clarification on this point is recommended.

IME recommendations:

i) Insert a sentence between the first and second sentences of 16.6.1.2(c) to read as follows:

> *The upper surface, or mesh, of the grid, upon which the tested explosives are placed, should be of sufficient size to prevent the tested explosives from falling into the fire after any packaging, if present, begins burning away.*

ii) Reword the comment at the end of Section 16.6.1.2 by inserting "*Note: "* at the beginning of the statement.

c) **Witness panels.** 56% of respondents indicated no support for tolerances to be quoted for witness panel size. Additionally, 75% of respondents agreed that alternative materials for witness panel construction should be allowed. IME agrees and suggests that the EWG review witness panel specifications, with the goal of providing some guidance regarding acceptable alternatives.

d) **Test specifications.** In response to the question, "Are there any 6(c) test specifications that could be better defined?", 70% of respondents answered, "no".

The main issues identified in this portion of the survey were fuel sources and construction of the fire. Of particular concern was the description of a "suitable method" of building a wood fire that is found in Section 16.6.1.3.2. It appears that some take this very expensive method as the only way to build a wood fire and that fires build of other lumber or wooden pallets are unacceptable. IME recalls discussions at recent EWG meetings where it was generally agreed that other methods, such as wooden pallet fires, are also acceptable, so long as the desired fire characteristics and duration are obtained.

Additionally, several comments were received that the procedure seemed less organized than those for 6(a), 6(b), and 6(c).

IME recommendations:

i) The EWG should review fuel sources for the test to determine if other methods are available that will serve the purpose, be readily available, and more environmentally friendly.

ii) Revise Section 16.6.1.3.2 by adding the following sentence to the end of the section:

> *Other methods of building a wood fire, such as using wooden pallets and/or scrap lumber, may also be used, so long as the desired fire is obtained for an appropriate duration of time (see 16.6.1.2(e) and 16.6.1.3.1).*

iii) The EWG should review the structure of the procedure to improve its readability and comprehension.

e) **Unnecessary or over-specifications.** 63% responded "no" to the question, "Are there any unnecessary or over-specifications in the 6(c) test?" Most of the comments received under this question have been addressed above, and where appropriate, IME has recommended some courses of action.

f) **Assessment criteria.** Slightly more than half (53%) responded that the 6(c) assessment criteria contained in Section 16.6.1.4 were adequate. Some of the questions concerned the definition of "mass explosion" (see discussion in para. 13.a) above), assessing fireballs and jets of flame, calculating burning time, assessing witness panel dent depth, and calculating mass-distance relationship when trying to evaluate energy of metallic projections.

It was observed that the second sentence in Section 16.6.1.4.2 is inconsistent with the definition of "mass explosion" as provided in Appendix B of the Model Regulations.

A suggestion was received that terms such as "fireball", "jet of flame", "fiery projection", and "metallic projections" be defined so that there will be more consistent interpretation and application of the 6(c) acceptance criteria.

It was observed that the concluding phrase of Section 16.6.1.4.6, which addresses hazardous effects being confined within the package, is not an evaluation possible in the 6(c) test, since the package has most likely been consumed in the fire. Commenters questioned why this statement is in the assessment criterion that leads to 1.4S. IME agrees that this is an inappropriate 6(c) assessment criterion and has confirmed that the statement was added during the development of the 6(d) test, which is used to evaluate hazardous effects that result from accidental function of an explosive within its transport package.

There seemed to be general confusion and lack of understanding of the significance of certain criteria, such as the energy level limits (8J and 20J) for metallic projections, the thermal flux and burning time criteria, dent depth limits, and so forth. Much of this information is contained in discussion documents that were developed during the review of the 6(c) test by the EWG in the 1990s. IME is in possession of most, if not all, of these historical discussion documents and suggests that it might be worthwhile to include some of this information in an introductory paragraph to the procedure so that users will understand their significance. Since IME has already recommended revising the heading of Section 16.6.1.1 to read "Purpose", perhaps a new "Introduction" section could be added.

Validity of the points on the curve and the data in the table in Figure 16.6.1.1 was questioned. Some observed that the data presented has not been borne out in their practical test experience.

IME recommendations:

i) Review Section 16.6.1.4.2 and ensure that the assessment provided is consistent with the definition of "mass explosion" as provided in Appendix B of the Model Regulations.

ii) Develop definitions for the terms "fireball", "jet of flame", "fiery projection", and "metallic projections".

iii) Revise Section 16.6.1.4.6 as follows:

> *If none of the events occur which would require the product to be assigned to Division 1.1, 1.2, 1.3 or 1.4 other than Compatibility Group S, ~~the thermal, blast, or projection effects would not significantly hinder fire fighting or other emergency response efforts in the immediate vicinity, and if hazardous effects are confined within the package,~~ then the product is assigned to Division 1.4 Compatibility Group S.*

iv) Add a new introduction section that discusses the theories, meanings, and significance of the various acceptance criteria.

v) Review the graph and data in Figure 16.6.1.1.

16. **Test 6(d).** Most of the discussion above about Test 6(a) is applicable to Test 6(d) as well. Some issues specific to 6(d) are reviewed below.

a) **Acceptance criteria.** 85% of the respondents indicated that the 6(d) acceptance criteria are well defined. Concern was expressed that minor nicks and scratches might be interpreted as a "dent" as described in Section 16.7.1.4(a). This has been discussed in past meetings of the TDG's explosives working group, and IME recalls that this is not the case. Some guidance to this effect should be provided in Section 16.7.1.4.

Also of concern was the wording of the criterion provided in Section 16.7.1.4(b). The feeling is that the words "capable of" are too vague. IME agrees and suggests that a revision of this criterion be considered.

Section 16.7.1.4(c) describes disruption of the packaging causing projection of the explosive contents. If this occurs, assignment to 1.4S is not possible. The question has been posed that, if the entire outer package is blown away, yet all of the contents remained in the area of the confines of the package, would this be considered a pass or a fail? IME believes that, in this example, since the explosive contents were not projected, that this would be a pass. However, discussions at a past meeting of the IGUS/EPP and at a past Chief Inspectors of Explosives conference indicate that there is not a consensus of agreement on this interpretation. Some clarification is needed and this could possibly be assisted by inclusion of some additional specific examples.

IME recommendations:

i) Provide some guidance regarding what a dent is and what it is not.

ii) Revise Section 16.7.1.4(b) as indicated below:

A flash or flame ~~capable of igniting~~that ignites an adjacent material such as a sheet of 80 ± 3 g/m² paper at a distance of 25 cm from the package.

iii) Consider providing some guidance regarding the issue described above concerning the outer package being blown away.

iv) Provide some examples that better illustrate pass/fail for articles such as detonators, shaped charges, detonating cord, air bag inflators/actuators, small arms ammunition, etc.

v) Ensure that it is clear that examples are provided for illustration purposes and are not to be construed as iron-clad acceptance criteria.

Consideration

17. The IME recommendations contained in paragraphs 12 – 16 above are not intended to be formal proposals for consideration by the TDG or EWG. They are intended as IME's suggestions for further discussion beginning at the 43rd Session.

18. The issues identified in paragraphs 12 – 16 above are those that IME has identified as the most significant. In total, more than 400 comments were received in response to the survey, and the TDG and EWG may wish to conduct a more thorough review of those comments, as presented in Annex 2.

19. IME remains at the service of the TDG and the EWG to continue to coordinate any future work on the review of Test Series 6 subject to those groups' desires and instructions.

Annex 1

Letter from the Alliance of Special Effects and Pyrotechnic Operators, Inc.
concerning UN Test Series 6 when used for explosives classifications

THE ALLIANCE OF SPECIAL EFFECTS
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Dear Mr. Boston,

I am writing on behalf of the board and membership of ASEPO, our non-profit, mutual benefit organization which represents hard-working men and women who create special effects for stage and screen worldwide.

We thank you for this opportunity to comment on this important subject. Since many of our general comments apply to several of the questions on the survey form, we've expounded on them here and only put brief notations with references to this letter in the attached survey form to avoid redundancy.

Our general comments:

<u>There is a need for regular, periodic review of a broad-based nature such as this survey.</u>

Periodic review of the methods and materials is a necessary part of keeping the tests current, relevant, and fully implementable at all levels. While we realize that such review is undertaken by competent authorities and other government entities via the United Nations meetings, it is important to realize that the need to perform these tests exists not only at official testing agencies but for anyone who is submitting materials for approval.

Seeking an explosives approval via testing is often a process associated with significant expenditure of time, and of financial and administrative resources. In all but the most certain cases, materials must be pre-tested by whoever is seeking the approval prior to doing so, as to be reasonably sure that it will pass. Further, such pre-tests are not infrequently performed more extensively, so as to attempt to detect and correct any unusual or infrequent behavior of the materials during the testing done for approval purposes, which could result in a costly and embarrassing failure.

Given this, the circle of stakeholders in the testing process is larger than may have been realized and which has apparently been involved to date. During its entire history, this is the first time our organization has been given a direct opportunity to comment, for which we are grateful.

In accordance with the principles of good governance, we would like to see such regular, periodic review of a broad-based nature, including outreach to stakeholders, surveys, formal and informal solicitation of comments, a confidential/anonymous "suggestion box" process, etc. continue, taking into consideration that:

-not all relevant stakeholders may be easy to reach through existing channels.

-some stakeholders may be reluctant to give input for fear of appearing ignorant or being perceived as complainers, etc.

-some stakeholders may seek to use, change or influence testing methods and materials with a view toward gaining commercial advantage, etc.

Naturally, the comments and suggestions received must be carefully and thoroughly examined for relevance and to be sure that the fairness, safety and accuracy of the test method is retained. We believe that the existing mechanism for doing so will, by removing any unsuitable suggestions. They cannot however reconstruct good suggestions which were never made, hence the solicitation of input should be as broad as practicable and reasonable.

<u>The test methods and materials should be selected with a view toward providing good value for data obtained, and regularly reviewed on that basis.</u>

Naturally, the safety and accuracy of test methods should be the primary consideration, not minimizing the cost, and we are certainly not advocating any short-cuts, watering-down, compromises, etc. which undermine their validity.

That having been clearly stated, we would like to add that including, retaining, or implying the necessity of wasteful, arbitrary, outdated or burdensome requirements which do not significantly contribute to the safety and accuracy of a test method, or which even detract from it, benefits no one. On the contrary, it has the potential to hinder innovation, impede improvement of products and freedom of expression, as well as lessen the respect for, and overall credibility of, the testing scheme.

Regular, periodic reviews should be conducted on that basis, including:

-whether the specific materials required by the test (e.g. witness screens) are still readily commercially available and what the trend is with respect to future availability.

-if the trend is negative, what steps can be taken to provide a suitable transition to materials which will foreseeably be available. Materials which provide the best value for data should be actively sought.

-whether the procedure can be streamlined, subject to reasonable limitations included in the description, based on previous testing experience with certain types of materials, or the addition of other test into the series. Such information should be added to the test description where applicable.

-the inclusion of new materials, technology or means of acquiring or recording data, initially on a trial or optional basis, with a view toward providing improved value for data or "extra credit" purposes i.e. further substantiation of, or correlation to test data from the existing method.

Against the above background, we would like to suggest several specific examples of possible areas for such review:

Regarding the requirement for 0.15 cubic meters of sample

Understandably, the testing methods appear to be based on the assumption that the materials are relatively powerful, being produced on a large, commercial scale, and will be shipped and stored in large quantities as well. While that may be a valid assumption in many cases, it must be taken into consideration that there are also many specialized or unconventional uses of explosives, including but not limited to motion picture/television/entertainment industry use, in which only limited quantities of often small devices are ever produced, transported and stored. In either case, the safety criteria are the same, and this should be taken into consideration during the testing process and the evaluation of the results.

Based on conversations with persons and organizations having authoritative knowledge on the subject, the requirement that enough packages are necessary to give a minimum total volume of 0.15 m^3 appears to be arbitrary and could be problematic in certain instances.

The only technical substantiation for such a large sample size we are aware of was that for devices which emit projections likely to cause perforation or indentation of a witness screen has a higher probability of striking one.

While that certainly has some validity, it seems to us that:

-in such cases, it would make more sense to specify a statistically significant number of devices than a 0.15 cubic meter volume, which in the case of large devices packaged singly might not be very many.

-this reasoning would not apply to devices which did not emit such projections.

In the case of small devices, 0.15 cubic meters might be thousands or tens of thousands of devices, which may be very expensive. Further, in the case of costly, specialized devices produced only in limited quantities, 0.15 cubic meters is likely to far exceed the quantity which would ever be shipped in actuality.

We would like to suggest that the requirement for 0.15 cubic meters of sample be reviewed and unless there is a compelling and substantial technical reason to the contrary, consideration should be given to:

-including a statement to the effect that the 0.15 cubic meters is an arbitrary amount included as an initial point of reference, but that the minimum amount of sample which produces valid results for a given material, plus a reasonable tolerance to err on the side of reliability, should be used.

-in cases where devices which emit projections likely to cause perforation or indentation of a witness screen are tested, the sample size and configuration should be selected on a statistically valid evaluation of that risk, rather than the arbitrary 0.15 cubic meters.

-including a statement to the effect that, especially for small items which previous experience would indicate are likely to be 1.4, testing should be done with a view toward simulation of the maximum likely shipment in the configuration(s) most likely to produce a failure rather than the arbitrary 0.15 cubic meters.

-if it cannot be determined with reasonable certainty that the results of testing with either the arbitrary 0.15 cubic meters or a smaller sample size can be applied to larger quantities, a limitation be placed on the approval for the maximum quantity per shipment, based on mutual agreement prior to testing between the competent authority and those seeking the approval.

Regarding mixed or combined tests

Given that the cost, etc. of testing small devices produced in limited quantities is relatively high, we suggest unless there is a compelling and substantial technical reason to the contrary, consideration should be given to allowing combining materials for testing, particularly in instances where the materials are likely to be shipped and stored together in actual practice. Naturally this would be subject to reasonable limitations, such as:

-all materials would be required to pass the combined test. If a single material failed, all would fail. Further, the lowest classification of the combined test would apply to all the devices tested, i.e. if anything in the combined test indicated 1.3 behavior (but not 1.1 or 1.2), all the devices would be classified as 1.3, even if the others were arguably 1.4, until further testing proved otherwise.

-the nature of the testing would readily accommodate it, such as in the 6(c) external fire (bonfire) test.

-the configuration tested was the one most likely to fail.

Examples of instances in which this concept could be considered include:

-a single design of device which was produced by a number of contractors, each of which would ordinarily require separate testing.

-devices which were similar in hazard, but too dissimilar in design to be considered a series or to be classified by analogy, each of which would ordinarily require separate testing.

-devices intended to be shipped or stored as a kit or set, but which might be shipped individually as well, and where it was unclear if the combination would increase or decrease the hazard i.e. the configuration most likely to fail was unclear but a broad, flexible approval was required.

Regarding making specific reference to commonly accepted practices in testing and classification

Naturally, we understand that 1.1.2 gives a competent authority discretion to dispense with certain tests, vary the details of tests, and to require additional tests when this is justified to obtain a realistic and reliable assessment of the hazards of an explosive. This is as it should be, and many competent authorities repeatedly use that discretion in certain instances in which it is logical to do so and generally accepted that the change is justified and provides equal or better results.

Unfortunately, though they are widely known and often intuitively obvious, these changes are not specifically spelled out or referred to anywhere. Because of this, our members have reported that

unfortunately, these reasonable changes made previously can be called into question or even completely excluded in cases where a competent authority experiences a change in oversight in the aftermath of a accident or inquiry, rapid turn-over or loss of knowledgeable personnel, loss of records or institutional history, etc. In such instances, a mindset of exact compliance and testing everything to "the letter" of the test description in all cases can prevail, simply because it is the most clear and easiest to defend if questioned for any reason, even if it is not justified to obtain a realistic and reliable assessment of the hazards of an explosive. Any deviation from the written procedure, however small, tends to be viewed as problematic and a reason for a great deal of added scrutiny, or even for rejection.

To address such cases, in the interest of fairness, uniformity and good governance, we suggest that consideration be given to making reference to commonly accepted changes, with a view toward listing broad concepts rather than quantifying specifics. Examples might include:

-that certain tests which supply redundant or overlapping information are generally dispensed with or conducted out of order, such as the 6(a) and 6(b) tests if the explosive passes the 6(d) test.

-that testing the largest and/or most likely to fail of a series of devices may be used as a variation instead of testing each single device in a family or series.

-that in certain cases, an explosive which is sufficiently similar to explosives which have been extensively tested can be classified by analogy with either limited or no testing.

We believe that many more similar concepts will come to mind if the idea is pursued, again with a view toward listing broad generalities and providing examples, while preserving the discretion given a competent authority in 1.1.2 to conduct additional test if they are justified.

Regarding tolerances

We believe that tolerances should be stated in all cases where they might apply, especially with regard to the thickness of witness screens, etc. for the simple reason that all commercially available materials have one. If no tolerance is stated, then those responsible for obtaining the material are in the unenviable position of either having to somehow find or make 3.000000 mm steel or risk being accused of making an unauthorized change in the procedure which directly affected the results.

A statement that common commercial tolerances, perhaps in connection with a particular technical or manufacturing standard, etc. are acceptable could be substituted if for some reason it was not possible to find a single set of tolerances which applied in all areas of the world.

In cases where exceeding the size specified in the existing test description does not negatively affect the test, or even improves it, the description should mention this, e.g. having witness screens for the 6(c) test which are a more convenient total size greater than 2000mm x 2000mm.

In any case, unless there is a compelling and substantial technical reason to the contrary, the specified thicknesses, sizes and tolerances should be based on commercial standards, not arbitrary sizes.

Regarding alternatives

Additional information to give guidance to those who have to acquire the witness plate material should be given, in terms of a range of properties, list of applicable standards and/or specifications, etc. Requirements should be made and stated with a view toward the broadest, most readily available range of materials which will give valid results, not the narrowest or most traditionally used.

It has been the experience of our members that materials traditionally used in creating special effects which were common and readily available decades ago, are now unusual and hard to acquire for any number of reasons. We believe that the same applies to certain materials referred to in the test descriptions, especially the aluminum required for the 6(c) witness screens.

Naturally, the cost and logistical effort in obtaining it are justified if this is truly the only aluminum which is suitable. However, given the wide range of other aluminum sheets which are more readily obtainable, we suggest that the matter be reviewed with a view toward including alternatives.

Requiring the use of witness screen materials which are difficult and costly to replace also encourages the use of them beyond what is ideal, which may mean that damage which would have been obvious on a fresh witness screen is overlooked, and test results are compromised.

Regarding pallets as fuel for the wooden crib fire in the 6(c) external fire (bonfire) test.

As stated previously, we suggest that materials be selected with a view toward providing best value for data. In the past, used pallets have been employed for this purpose. If selected and used with reasonable care (e.g. not solid topped and having a spacing so as to allow a balanced fuel/air ratio), we believe that they can provide an entirely suitable fire yet because they are not specifically referred to in the test description, in certain instances the perception has become it is essentially required to use dimensional wood arranged exactly as described instead, at considerably greater cost.

While there is nothing in the current test description which excludes or prohibits used (and possibly damaged) pallets as fuel, this is in practice unfortunately not the same as if they were specifically allowed.

Given this and that used pallets are inexpensive, relatively available world-wide and made in standardized sizes, we suggest that a configuration representing their use be included.

Regarding the safety of those conducting the tests

We understand that the test descriptions assume competence on the part of those conducting the test and hope that anyone who would undertake to do these tests would have the requisite technical background to take the necessary safety precautions, or have the common sense to arrange to have them done by those who have such a background if they did not. That having been stated, it is nonetheless likely that organizations worldwide which have limited or no experience with these tests will at times attempt to conduct them based on the descriptions so as to pre-test the material and packaging prior to submitting them for actual approval testing.

In the interest of accident and injury prevention, we suggest that the descriptions err on the side of including essential safety precautions and procedures learned from experience and employed in practice by competent authorities to the degree practicable, e.g. that protective measures must be

based on the maximum foreseeable hazard e.g. a mass explosion, not merely the minimal hazard hoped for during the test.

Regarding environmental considerations

Naturally, we understand that these tests are intended to be conducted in a suitable, environmentally insensitive area. That having been stated, we would like to suggest that including simple environmental protection tips (e.g. using temporary ground cover impermeable to kerosene such as plastic sheeting when setting up the wooden crib fire for the 6(c) external fire (bonfire) test can help prevent the liquid fuel from soaking into the ground, thereby minimizing the environmental effect of repeated testing at a particular location, or the use of LPG gas fire as ignition for the wood instead of kerosene) would be helpful and in keeping with the times.

Please contact us should you have any questions or want further explanation of our views.

For the Board of Directors,

Tassilo Baur
Chair, ASEPO Compliance Committee

Attachment:
Test Series 6 Survey

Annex 2

Summary of Test Series 6 Improvement Survey Results

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
1. Is the purpose of the 6(a) test adequately defined?	22	73%	8	27%	30	
Mass explosion in the purpose could be better defined - see also results section						
It is well defined to those who understand that detonators should not be used to test propellants. There is a risk that uneducated regulators will want to test all samples with a detonator.						
What is an explosion in the context of this instruction? Perhaps it's explained elsewhere. For IM/HC we don't use a word like explosion as it can have many different meanings. What is a mass explosion? Is it "mass" if some some of the material or some of the items "explode"? Or, does it require an "explosion" of all the material.						
Per the Orange Book glossary definition, a "mass explosion" is one "which affects almost the entire load instantaneously." A load is implied to consist of multiple packages. So when only a single package is tested, how can we be realistically assessing whether a mass explosion is the outcome?						
Yes but the assessment criteria 'explosion' is not robustly defined						
Para 16.4.1.1. titled "Introduction" should be changed to "Purpose" and changed to read - "The purpose the single package test is to determine the level of reaction violence outside the container when the contents of a single package of articles is subjected to an appropriate stimuli. The test results from test 6(a) are then assessed to determine if the next sequential test in series 6 (the Stack Test) is required, or not, in order to assign an appropriate classification and division as shown in Figure 10.3"						
The 6(a) and 6(d) tests also give valuable insights as to whether the reaction is largely confined to the package or not. To imply its value is only in separating 1.1 from other classes is misleading.						
For testing articles, the package should contain multiple items. Reword definition so that the test on articles is to initiate one single article within the full package. If articles contained within the package are of different sizes, then the largest NEQ should be initiated. If the package only contains a single article, then the 6(a) test is not appropriate, and the 6(b) test should be used.						
The current purpose is not accurate. Suggest something like: "This is a test on a single package to determine if there is mass explosion of the contents when an explosion is intentionally caused within the package." While defining the purpose better would help clarify the test, our opinion is that whether or not a product mass explodes under the test conditions is not the best determining factor to help define the hazard level of a product if a load is involved in a fire from internal or external sources, or an explosion from internal sources, as stated in 16.1.1. It does not determine the severity and hazard level of an explosion.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
2. Are the materials needed to perform the 6(a) test adequately described?	18	62%	11	38%	29	
confining material should be described elsewhere in the document as inert (non-contributing) material; if not, then a specific description of 'confining material' should be provided in 6(a) language.						
The standard detonator is not standard. the specifications are inconsistent and archaic. It is many years since I saw a detonator that had a dimple in the base. And why might one not use a shock tube detonator?						
Put an "or" in between a & b to clarify that both are not required but only one is depending which material using.						
More definition is needed on confining material (as well as "surrounded"). How confining should it be? As written it allows too much variability. What is a package? Is it a single container? Or, is it a pallet of containers as might be found in a logistics configuration? More definition is required.						
The test should be recorded on video. Blast measurement equipment is described, but the use/accuracy of such gauges can be hampered by the confinement method.						
Instrumentation is the minimum required: testing organisations can deploy blast measurement gauges; high speed and real time photography; fragment collection, documentation and analysis of acceptor breakup. For complex articles or large items the need for additional instrumentation becomes more important to interpret the response of acceptors, which may not be obvious except if they detonate. For example, the donor explosive effects can mask evidence of the level of acceptor response by disrupting and scattered them. UN TS 6(c) mentions high speed photography but we would propose that it is equally or more important for TS 6(a) and (b).						
16.4.1.2 "Blast measuring equipment may be used." Can you give examples of what equipment could be used, without making it prescriptive?						
The type of metal and thickness should not be specified. Rather the purpose for a witness plate should be stated. For example " a metal witness plate of a thickness and material capable of evidencing forces generated external to the package"						
1) "Sand Confinement" - typically can use boxes of pack of same approximate size and shape filled with confining material.						
The list of materials reads as though a detonator AND an igniter will be needed. In reality it will be one OR the other. Suggest a) and b) of para 16.4.1.2 are amalgamated to indicate one or the other is used.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The result of the test is often contingent on the degree of confinement. The description allows a broad latitude in the type of confinement used and will result in variable results. The detonator is specified as a "UN detonator". Detonators meeting the exact UN definition are impossible to obtain.						
Standard detonators are not always readily available						
3. When preparing to perform the 6(a) test, is it clear when to use a detonator and when to use an igniter?	21	68%	10	32%	31	
The wording is unclear - whatever initiator is needed to function one device (and I don't think that is clear)						
It is to me.						
Actually, it is well defined, but we are aware of instances recently where CAs are requiring use of detonators on devices clearly intended to be initiated by igniters. Although this is within their prerogative, there is no guidance on how to interpret results of such tests.						
See above explanation (3rd comment in #2). (not sure when (c) applies)						
My assumption is that an igniter is used if it's a material that's intended to have a burning reaction versus a detonation. But, most such materials will not "explode" even if confined (unless the confinement is too great and the confinement over-pressurizes. And, if it's a package with multiple items it seems only a single item is "ignited". If another item ignites due to the confinement of the exhaust gases is that a "mass explosion"?						
Describe igniter and detonator, specify the use of elec or non elc dets.						
It should be better assigned when we have to use detonator and when igniter, specially if the whole munitions includes different components like high explosive or propellant.						
When per the Test Series 6 introductory paragraph the overarching goal is to determine which hazard division and compatibility group in Class 1 most closely corresponds to the behavior of a load that becomes involved in a fire or an explosion, how the explosive is intended to be functioned is irrelevant because the articles will be subjected to whatever stimuli a mishap generates. And whereas such mishap severity is unpredictable, shouldn't we always be favoring some appropriate conservatism in our assessment of a load's potential misbehavior by insulting our donor with a detonator in at least one trial?						

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
It is clear but there is a different concern. Currently, high explosives would often be initiated in a detonation and propellants would be ignited in a burn. A potential problem arises if one considers the response of a detonable propellant which is ignited vs initiated (with a detonator). The first test may eventually give rise to a HD 1.3 vs. the second giving a HD 1.1 classification. We would propose that this is nonsensical because propellant can often be more sensitive to accidental ignition than high explosive. Hence, what is the logic behind exposing propellant to a less severe test? Stringent fuze/igniter design requirements mean that the probability of an accident caused by the igniter or initiator malfunction is much lower than, for example, transportation accidents leading to fire. Contribution of the igniter or initiator to the final response has also been reduced or limited through design or may not be present during transportation. Furthermore, such an approach does not give information on the maximum credibly event and is not a consistent approach to evaluating hazard. Recent accidents have indicated that this may be an important problem.						
No it is confusing. The phrases "initiating stimulus and initiation" are used throughout to mean functioning by detonation shock (either the item's own means, or a #8 blasting cap for packaged substances), but then in para 16.4.1.5 "Examples of results", the table lists "Initiation Systems" to be either a detonator or and ignitor (see middle column of the example table). Herein lies one point of confusion. Further, there seems to be an error in paragraph 16.4.1.3.5 Currently reads - "The substance or article should be initiated and observations.....". Recommend change to - "The substance or article should be functioned and observations...." Rationale for recommended change; the paragraphs proceeding 16.4.1.3.5 take great care to distinguish between the appropriate means of functioning the test article, i.e., either by using an initiating stimulus, or an igniting stimulus (see 16.4.1.3.1,& .2 &.3). Consequently it is recommended that the word "initiated" be replaced by the word "functioned" because the word "functioned" is inclusive of both means of subjecting the test article to the appropriate stimulus; whether the appropriate stimulus is either an initiating stimulus such as a booster or #8 cap that induces shock to the article in the center of the package, or if the appropriate stimulus is an igniting stimulus for inducing a deflagration in the article in the single package.						
Igniter vs. detonator is currently dependant on intended design. It may be useful to revisit this approach with the goal of ensuring the proper hazard classification for transportation and to ensure that the test criteria continue to provide classifications consistent with the Model Regulations' Hazard Class/Division definitions.						

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Only when testing substances. For testing articles, use similar terminology to 16.4.1.3.2 (a) & (b).						
4. The test description calls for 3mm mild steel. Should a tolerance for the thickness be provided?	10	36%	18	64%	28	
there should be no tolerance for thickness, and recommend a standard hardness parameter be included in the language.						
Perhaps. I would be happy with a "nominal thickness" of 3 mm and I don't know what sort of tolerances there are for steel plate. It is too easy to allow +/- 10% without really knowing what the normal variations are.						
All manufacturing plans allow for tolerances, so it seems reasonable that tolerances for the thickness of the witness plate should be developed. Maybe +/- 0.5mm?						
But, I would do this only if the rest of the procedure is tightened up. And, I'm not even sure the 3mm would be appropriate for all munition types. Is it supposed to replicate some structure that could be damaged in this "mass explosion"?						
If you're testing an item where a witness plate will be useful in determining the reaction, I believe you're conducting the wrong test. You should skip the Single Package and move right to the Stack.						
The optimum material to use for a witness plate depends on the type and velocity of the expected fragments. For heavy articles with steel walls, a steel witness plate with a thickness of at least 25 mm is recommended. However, for articles with aluminium skins or very thin steel skins, an aluminium witness plate may provide better results. For articles with plastic or composite skins, witness plates may not be that useful.						
The type of metal and thickness should not be specified. Rather the purpose for a witness plate should be stated. For example " a metal witness plate of a thickness and material capable of evidencing forces generated external to the package"						
1) A tolerance that includes 0.125" (1/8 in.) should be provided since 3mm steel can be a difficult spec to find in the US. 2) In the US, standard steel sheets are designated by gauges. An 11 gauge steel call out corresponds to a thickness of 0.1196 (+/- 0.008). This equates to a 3.04 mm thick plate. The 3 mm requirement would fall within the manufacturing tolerances of this sheet which equate to a range of 2.83 mm to 3.24 mm. The next thinnest gauge available is 12 gauge which corresponds to a thickness of 0.1046 inches (+/- 0.008). This equates to a thickness of 2.66 mm which could be used and would be significantly more conservative. A tolerance on the thickness would allow for the use of 11 gauge material which, in our opinion would be acceptable thickness.						

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
3) If there is a tolerance it should be wide (~0.5mm), since mild plate steel can vary in both thickness and strength. A tolerance would take into account the inherent tolerances already introduced by the manufacturing process. 4) If there is a need to tighten the test, better defining "damage" to the witness plate and "disruption" of confining materials are more viable issues to address.						
Generally, some tolerance should be provided for any dimensional specifications.						
Yes; ± 0.5mm to permit use of imperial-sized materials. Suggest specifying CR4 grade or similar.						
If 3.0±0.5 mm is implied there is no problem (see preamble of the UN Recommendations). But if an ISO or equivalent standard is implied, the product may be difficult or expensive to obtain. There would be no benefit to a tighter tolerance on the steel thickness in this test. For clarity, the tolerance should be specified in the test description.						
In our opinion, to determine whether there is mass explosion the exact thickness is not critical. Current description is adequate.						
Today the thickness is 3 mm so it could go from 2.6 to 3.4 mm, i think this cap is to important. A thickness of 3+/-0.1 mm should be more precise and not so difficult to obtain for a steel plate.						
Always good practice to quote a tolerance						
This question is irrelevant. Such test is not suitable for a round robin test, where test conditions have to be specified to every detail. The specification is “technical”. Valid results can be achieved with deviating thickness.						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. Please see additional comments in our attached letter.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
5. Should other materials be considered for the witness plate?	6	21%	22	79%	28	
some discretion could be allowed. we are not looking for detonation in this test, only mass explosion.						
No good answer to this. If the idea is to have a consistent test for comparison purposes, then a single material should be specified, and mild steel is not a bad choice. If the idea is to somehow replicate some structure, then there might be a better choice.						
Also aluminium or some fibre materials may be used, specially for small calliber product.						
If you're testing an item where a witness plate will be useful in determining the reaction, I believe you're conducting the wrong test. You should skip the Single Package and move right to the Stack.						
The optimum material to use for a witness plate depends on the type and velocity of the expected fragments. For heavy articles with steel walls, a steel witness plate with a thickness of at least 25 mm is recommended. However, for articles with aluminium skins or very thin steel skins, an aluminium witness plate may provide better results. For articles with plastic or composite skins, witness plates may not be that useful.						
Top level documents, such as the "Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria" should be written with a preference towards less specificity in order to foster the develop of best test and assessment practices, as innovative technologies, application techniques and materials become available over time . Global harmonization of requirements and methods for classification and labelling of chemicals, as well as, energetic devices, does not mean that every test article should be assessed exactly the same way. Each test article is different and proper characterization of their hazards mandates some flexibility in test design as monitor by national authorities and experts. Further, the types and kinds of energetics devices will continue to become evermore board and diverse.						
Possibly a thinner plate should be used. There is an inconsistency within the test series for determining candidates for less than HC/D 1.1 materials. Series 5a test uses a 1 mm steel plate. If the substance fails this test it stays in HC/D 1.1 realm. However, non-blasting agents/substances (which actually may be easier to ignite) use a 3mm plate in the 6a test.						
The current witness plate is sufficient to determine if there is mass explosion.						
Additional information to give guidance to those who have to acquire the witness plate material should be given, in terms of an acceptable range of properties, list of applicable standards and/or specifications, etc. Please see additional comments in our attached letter.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
6. Are there any 6(a) test specifications that could be better defined?	10	37%	17	63%	27	
Some testing labs and CAs interpret a hole in the witness plate as a failure of the test and don't give any thought to whether mass explosion has occurred. The test is failed if a mass explosion occurs and not simply because there is a hole in the witness plate or the confinement was scattered.						
For articles, this test requires an item near the center of the package to be functioned. Is this always the best location for the donor? Shouldn't the donor location be the one that gives the maximum probability of propagation and the worse case effects external to the package? If one location doesn't fulfill both of these conditions, then it could change among the test iterations. I'd also recommend that one of the iterations be conducted unconfined to better evaluate effects external to the package.						
16.4.1.3.2(c) "gives a '-' result..." Please use the word negative, instead of this dash sign. It is pretty vague, particularly to non-native English users.						
Para 16.4.1.3.2(c) - Suggest better defining/illustrating how and what substance response levels justify waiving of tests with detonators, as well as, justification for waiving tests with ignitors. Rationale; It is likely that a person can miss read paragraph 16.4.1.3.2(c). It is overly tricky to follow. Procedures and requirements dealing with explosive safety should not be easily misinterpreted.						
1) Substances that are tested in the 6(a) test with an igniter, should also be subjected to at least one trial of either a 6(a) (with detonator) or 5(a) test. In my opinion, any substance that is cap sensitive should not be classed as other than a 1.1, regardless of its intended use. 2) Orientation of packaging on the steel witness plate could be specified. Perforators (shape charges) packed horizontally vs. vertically to steel plate.						
Under 16.4.1.4 (d) 'Disruption and scattering of the confining material' Define how much is acceptable; for instance, if a sand-filled box is seen to move on the video, is that considered to be disruption?						
Mild steel covers a wide range of specifications. Suggest tightening this.						
The result of the test is often contingent on the degree of confinement. The description allows a broad latitude in the type of confinement used and will result in variable results. The detonator is specified as a "UN detonator". Detonators meeting the exact UN definition are impossible to obtain.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Disruption and scattering of the confining material is included in the method of assessing results (16.4.1.4), yet the confining material type and amount is not specified well enough to assure that they will not affect the amount of disruption and scattering. Either the confining material should be better defined, assessment of disruption and scattering should be better defined, or disruption and scattering of confining material should be removed as a method of assessing results.						
16.4.1.3.4 "The preferred method of confinement consists of containers, similar in shape and size to the test package.....placed as closely as possible around the test package." Completely surrounding the test package. This adequately describes the confinement. Remove the minimum requirement.						
7. Are there any tolerances associated with the 6(a) test specifications that could be better defined?	10	36%	18	64%	28	
there should be no tolerance for thickness, and recommend a standard hardness parameter be included in the language.						
16.4.1.3.3(b) "caused to function in designed mode..." or "caused to function with same effect..." - does this mean the exact amount of initiation or ignition NEW in the design (that is not present in the packaged article) should be used to ignite or initiate the article? 16.4.1.3.5 "evidence of thermal effects..." can this be determined by packaging components' burnt or blackened state? "performed three times" can we re-use undamaged components and containers in the second and third tests?						
Top level documents, such as the "Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria" should be written with a preference towards less specificity in order to foster the develop of best test and assessment practices, as innovative technologies, application techniques and materials become available over time . Global harmonization of requirements and methods for classification and labelling of chemicals, as well as, energetic devices, does not mean that every test article should be assessed exactly the same way. Each test article is different and proper characterization of their hazards mandates some flexibility in test design as monitor by national authorities and experts. Further, the types and kinds of energetics devices will continue to become evermore board and diverse.						
16.4.1.2 (d) A better approach would be maximum 3mm thickness, rather than 3.0mm although that in itself implies that a level of tolerance to 1.d.p is acceptable. I have no experience of the 6(a), but considering the extent of confinement around the package is defined, would it be appropriate to also define the size of the witness plate.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
If, when testing articles, the impulse doesn't propagate to the other articles in the package, is there a need to carry out the 6(b) test? Clearly if there is no propagation within the package, there will be no propagation to adjacent packages in the 6(b) test.						
If 3.0±0.5 mm is implied there is no problem (see preamble of the UN Recommendations). But if an ISO or equivalent standard is implied, the product may be difficult or expensive to obtain. There would be no benefit to a tighter tolerance on the steel thickness in this test. For clarity, the tolerance should be specified in the test description.						
Disruption and scattering of the confining material is included in the method of assessing results (16.4.1.4), yet the confining material type and amount is not specified well enough to assure that they will not affect the amount of disruption and scattering. Either the confining material should be better defined, assessment of disruption and scattering should be better defined, or disruption and scattering of confining material should be removed as a method of assessing results.						
It could be better to defined more precisely the sand used for the confinement => the maximum grain size)						
Always good practice to quote a tolerance						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. Please see additional comments in our attached letter.						
8. Are there any unnecessary or over-specifications in the 6(a) test?	6	22%	21	78%	27	
In certain circumstances, 6D test results could be used in replacement for 6A if there is no mass detonation and effects outside the package are limited.						
Yes, the need to use a standard detonator.						
Just the tendency to misapply the results in determining if mass explosion has occurred. See 1st comment under #6 above.						
16.4.1.4 "otherwise, proceed to a test of type 6(b)..." this contradicts part 16.2.2 that provides examples of when test 6(b) can be waived, even if the results of 6(a) are not a mass explosion.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The type of metal and thickness should not be specified. Rather the purpose for a witness plate should be stated. For example " a metal witness plate of a thickness and material capable of evidencing forces generated external to the package" Top level documents, such as the "Recommendations on the Transport of Dangerous Goods Manual of Tests and Criteria" should be written with a preference towards less specificity in order to foster the develop of best test and assessment practices, as innovative technologies, application techniques and materials become available over time . Global harmonization of requirements and methods for classification and labelling of chemicals, as well as, energetic devices, does not mean that every test article should be assessed exactly the same way. Each test article is different and proper characterization of their hazards mandates some flexibility in test design as monitor by national authorities and experts. Further, the types and kinds of energetics devices will continue to become evermore board and						
9. Are the assessment criteria that are used to distinguish between different explosive Divisions adequately defined?	15	54%	13	46%	28	
The issue of minor blast (which is consistent with 1.3 even) is not well dealt with. Similarly with "disruption" - how is disruption, and how much disruption measure						
So long as the criteria aren't overly interpreted or misinterpreted.						
16.4.1.4 Clarify a-d Definition of damage? How do you measure a blast? (eliminate or be more specfic) Duration? Scattering? Is a sandbag that falls off of a pile considered a "disruption" or a bag that lifts off the pile and then falls back to same location considered a disruption?						
What is a crater? You can create a hole in the ground from a propulsive reaction. What is the damage to the witness plate? Again, this could be caused by a propulsive reaction. And, it could be caused by fragments thrown from a type IV or type III reaction, or from a type II or type I reaction. How is the "blast" measured? Is it directional overpressure? This could be caused by propulsion. Blast could also be from type I, II, III reactions or a pressure burst of the case. A propulsive reaction could scatter the confining material.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The assessment criteria doesn't make sense for a single package test. The criteria determines if you're a candidate for HD 1.1. If you're a candidate for HD 1.1, why would you be conducting a Single Package. The criteria should be determining whether a Stack test is needed.						
Additional guidance would be useful on how to interpret the response level of acceptor articles e.g. detonation, deflagration or explosion. the package. A useful starting place would be to consider those developed for UN TS7, which can be provided if required. This would address concerns that terms such as explosion are not robustly defined; even more difficult is mention at 16.2.2 (b) of: or explode so feebly. Linked to this would be improved instrumentation and analysis methods mentioned earlier and below. The evidence for mass explosion is defined as follows: (a) A crater at the test site; (b) Damage to the witness plate beneath the package; (c) Measurement of a blast; and (d) Disruption and scattering of the confining material. However, this could be observed for the initiation of a single donor article (see comments at 2). Hence, there is a need to discriminate donor and acceptor explosive effects.						
16.4.1.4(a), (b), and (d) are clear. However, 16.4.1.4(c) is too vague - "measurement of a blast". First issue is that 16.4.1.2 states that blast equipment MAY be used (was "blast" suppose to be step (e) under 16.4.1.2?). If it is not used, how can you measure any blast? In addition, blast is not defined and substances and articles with a "minor blast" can be classified as 1.3 [UN Model Regulations, 2.1.1.4(c)]. Please identify a measurable threshold between minor and major blasts, or define its effects (e.g. debris scattered x meters from package).						
Paragraph 16.4.1.4 says "Mass explosion (see definition in Chapter 2.1 of the Model Regulations). However Chapter 2.1 of volume 1 Model Regulation 16th revised edition does not list a definition of Mass explosion in the definitions sections which are 2.1.1 and 2.1.3. Rather the definition of mass explosive is somewhat hidden in paragraph 2.1.1.4(a). Also suggest consideration be given to changes the phrase "mass explosion" to "mass detonation/explosion" --- The assessment criteria is not adequately defined; for example para 16.4.1.3.2 (c) states; "If a substance gives a "-" result (no propagation of detonation) in the Series 1 Type (a) test, the test with the detonator may be waived."						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
For the UN gap test the words "detonation transfer" should be used instead of propagation, because the test assessment criteria, i.e, (a hole punched in the witness plate or tube is fragmented completely) is clearly looking to see if a steady state detonation is occurring (or not occurring) within the substance under investigation. The meaning of the word "detonation" is extensively defined and understood in the scientific literature. Further, the word "propagation" as used in the entire Orange Book should be defined as the transfer/communication of any kind/type of reaction mechanism (burning,deflagration, explosion or detonation) between like substances, articles, items, munitions. Rationale - this change will foster the Orange Book's intent of achieving greater global harmonization of test and labeling, as it will enable testers and developers of energetics / energetic devices to speak in a common language that is based in proven scientific reality.						
1) Define what a crater is (diameter/depth of hole). Ground conditions may affect whether a crater is formed. 2) the criteria is "mass explosion". To help aid in this, define what is meant by "disruption and scattering of the confining material". Is "disruption" ok as long as "scattering" does not occur? "Heaving" or "sluffing" of the confining material do not seem to explain a "mass explosion". This example of mass of explosion could be better defined. 3) The criteria "damage to the witness plate" provides a wide range of interpretation. What is "damage"? any slight discoloration? bowing? well defined indentation? perforation of any degree? or only a definite hole? size of hole or dent? 4)The criteria "disruption of confining material" provides a wide range of interpretation. How much disruption is allowed? how much is too much? How to define for propellant or smokeless powder or grenade which needs to vent (disrupts sand) yet clearly has no crater?						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
5) Quantifying percentage of recoverable vs. percentage which functioned- Define "mass detonation" units damaged by pressure wave, not sympathetic detonation. 6) Each product dependent on design has critical parameters that override other keys. 7) MTC is technical manual written to generically address majority of explosive materials and devices. However, it is a guideline which should allow labs to discern which critical parameters are crucial for any given substance/article.						
Item b) of para 16.4.1.4 states that damage to the witness plate can be used to indicate that a 1.1 event has occurred. 'Damage' is too vague. This could be small dents, large dents, perforations or tears.						
The 6(a) test essentially assesses whether the material is a candidate for a 1.1 classification; it doesn't assign into other Divisions at this stage. The 6(c) test is the primary test for assigning Division.						
1) Define what a crater is (diameter/depth of hole). Ground conditions may affect whether a crater is formed. 2) the criteria is "mass explosion". To help aid in this, define what is meant by "disruption and scattering of the confining material". Is "disruption" ok as long as "scattering" does not occur? "Heaving" or "sluffing" of the confining material do not seem to explain a "mass explosion". This example of mass of explosion could be better defined. 3) The criteria "damage to the witness plate" provides a wide range of interpretation. What is "damage"? any slight discoloration? bowing? well defined indentation? perforation of any degree? or only a definite hole? size of hole or dent? 4)The criteria "disruption of confining material" provides a wide range of interpretation. How much disruption is allowed? how much is too much? How to define for propellant or smokeless powder or grenade which needs to vent (disrupts sand) yet clearly has no crater?						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
No criteria are listed for the four types of "evidence". The tester has to look at the "evidence" and make a decision. It is also necessary to consult the UN definition of "mass explosion" when coming to a conclusion. Outcomes from the test could vary considerably depending on the conditions of the test and the judgment of the tester. Unfortunately setting quantitative criteria for this test would be difficult. Many factors other than properties of sample would affect the output of the test.						
(1) There is no definition of what constitutes damage to the witness plate that would be evidence of mass explosion. (2) Measurement of a blast is listed as a test criteria (16.4.1.4c), but is not included in the procedure and is without guidance for levels that would be evidence of mass explosion. (3) There is no definition of what constitutes disruption and scattering of confining material that would be evidence of mass explosion. This is further complicated by lack of clear guidance for type and amount of confining material that would make it possible to fairly assess the results. See Question #6 on that topic. (4) Observations are suggested (16.4.1.3.5) for thermal effects, projection effects, detonation and deflagration without guidance for evaluation as evidence of mass explosion. These observations are not included in the test criteria (16.4.1.4) for assessing results, leaving it unclear as to how to apply the observations to the assessment of mass explosion. (5) Explosion or damage to explosive articles in the package other than the one intentionally functioned are not included in the test criteria and method of assessing results (16.4.1.4) for evidence of mass explosion, yet are commonly used for that purpose. It is suggested that they be included, with guidance for assessing results as related to evidence of mass explosion.						
10. Use the space below to provide any other comments about the 6(a) test.						
There is no definition of what "damage" to the witness plate is. A scratch, a dent, deformation? A clear definition should be provided.						
Why are some articles which have no characteristics of a mass explosion subject to the 6(a) test just because they must pass the series 6 testing. Some way of opting out should be allowed or stated.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
I have a problem with confinement. As already noted, it's just too variable as now "specified". In some cases it has been extreme - burial in sand. It that's done it hinders our ability to assess the reaction. But, more importantly, it could get test operators killed. If a single item is tested, we are fairly safe to assume that we initiated that item and it reacted. However, if there are multiple items in the package how can you tell exactly what has reacted under the sand? Is there damaged energetics, perhaps even cooking off? Have safety devices been compromised? I'm sorry, but I hate this test as currently run.						
IM-tests and test for transport should be harmonized within some time.						
The 6(a) test has become immaterial. Its results are not useful as an indicator of Division 1.1 mass explosion candidacy, nor are they particularly useful, mainly due to the confinement, in terms of screening for inclusion in Compatibility Group S. The unconfined 6(d) single package test variant seems better suited to fill that latter niche. The relationship between 6(a) and 6(d) should be explained to preclude both tests from being conducted.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Typical techniques to help identify the level of response: It is essential to be able to distinguish between the debris of donor and acceptor articles. Consideration could be given to colour coding the acceptors, for example by painting the external surface of each acceptor munition a different colour. Blast over pressure is seen as a key discriminator in determining the level of reaction of acceptor articles, particularly if they are capable of detonating. It is important to estimate before the test the likely response of the article and the associated blast overpressure so that gauges of appropriate scale can be used. It can also be useful to calibrate blast overpressure measurement by measuring the output of the detonation of a single article, which will provide a baseline for comparison in subsequent 6(a) (b) and (c) tests. Typically 2 sets of gauges should normally be sited at 5, 10 and 15 m but this may need to be adjusted to account for the article size or expected severity of response. Guidance on the use of witness plates could be improved: it can be useful to site witness plates beneath and on 2 or 3 sides of the articles under test. It is useful to position a witness plate adjacent to or beneath the donor as well as the acceptors, so that the witness damage from the full detonation of the donor can be compared with that of the acceptors. A detailed debris map is seen as an essential element for all tests. The map should show the location of each significant item of debris, recording its identity, mass and distance thrown. In order to achieve this, it is essential that the test arena is cleared of all debris from previous tests before any test is performed. Once collected they can be photographed, separated, grouped by individual articles, and weighed (colour coding essential). Fragment size and velocity can also be measured using absorbent material, such as strawboards, fibreboards or soft plaster panels to catch the fragments.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Additional guidance could be provided for articles which contain more than one major explosive containing component. For example, which component should be reacted (or both simultaneously, or whether individual component tests should be conducted to better understand the interactions.						
It is essential to be able to distinguish between the debris of donor and acceptor articles. Consideration could be given to colour coding the acceptors, for example by painting the external surface of each acceptor munition a different colour.						
16.4.1.3.5 "If the results of the recommended number of tests (three) do not enable unambiguous interpretation of the results, the number of tests should be increased." Does this mean that if no detonation or explosion occurred on the first two tests, but it does occur on the third test, that we should test again to verify the third test? This would seem to refute the concept of a decisive result meaning you stop testing and declare it 1.1. OR is this intended to mean a partial detonation or partial explosion?						
For some NATO/US military devices, those that contain "smaller" amounts of energetic substances, the series 6(a) test results can be used to justify a passing assessment for the Insensitive Munitions/FHC Sympathetic Reaction test defined by STANAG 4396 Ed2 by applying the same logic as given in para 16.2.2, that is; if the contents of the package respond so feebly as would exclude the possibility of propagation via any form of stimulus(blast, fragments, fire, heat) that could otherwise enable a sympathetic reaction from one package to another in test type 6(b). If this is shown to be true then the likelihood of sympathetic detonation (The IM requirement per AOP-39 Ed3, para 5.5.2 table 1.) Note; From many "larger" munitions the Test 6(b) stack test requirement is often accomplished through conduct of the sympathetic reaction(SR) test prescribed by NATO STANAG 4396 Edition 2, which is called out in MIL-STD-2105D and in TB700.2. ----------						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
I was unable to complete the whole survey in the time I had available to work on it. I did however generate a comparison table, that compares and contrasts key test parameters between orange book test series 6; test 6(c) and NATO STANAG 4240Ed2 ratification draft 1 dtd 2002. The comparison sheet compares; configurations & directional orientations of articles, number of trials, number of articles per test, circumstances for test waiver requests, flame temperature requirements, instrumentation, data collection requirements, test data assessment and passing criteria versus division assignment. I was planning to use the comparison sheet to assist me in providing comments on test 6(c). If I have time(post dead-line 15 May 2012) I still plan to fill in the survey for test 6.c and perhaps 6(b) also. A testing program could be readily devised to greatly improve the ability of this test to provide added value to the classification scheme. Some baselines using varying amounts of specifically packaged 1.1 and 1.3 explosives could be established. These would provide a means of calibrating not so much the test as the test witnesses (and reviewers) in regard to disruption of confining material and damage to the witness plate. This would give some criteria for comparison for using the 6(a) [and at least one trial of a 6(d)] test as a reliable discriminator for more than 1.1. In addition, related to Question 3 above, we should ask if there is a gap between the classification arrived at through testing and the hazard class definitions given in the Model Regulations.						
1. A depth of the dent made on the witness plate and a sound level can be useful criteria for 1.1 classification. 2. For some countries, It is not easy to prepare a wide proving ground capable of performing test series 6. Therefore, introducing some screening procedure before test series 6 may be preferable.						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Clarification that the 6(a) test, when testing packaged articles, should only be carried out on packages containing multiple articles. The test is to determine whether there is a mass explosion of the contents; so initiating the sole article in a package of one will obviously result in a 'mass' event! In this case, single-item packages should default to the 6(b) test instead. We are often required to carry out one of the three 6(a) tests in an unconfined condition, by our customer (US DOD). This is to assess the degree of package disruption in a similar way to the 6(d) test, even though we may not be seeking a 1.4S classification. Could this be a useful aspect to the testing?						
The test description says that blast measuring equipment may be used. This is a good idea but no guidance is given. Any measurement recorded would be dependent on the devices used, their setup, and the data treatment. Relating the measurement to the sample may be difficult because energy will be consumed in dissipating the confinement and any shock wave produced may not be propagated in a symmetrical pattern. Additional guidance would help. Consideration should also be given to the use of standard blast monitoring equipment that measures both ground vibration and air blast. Such equipment is commercially available and standards exist.						
1. Section 16.4.1.4 instructs readers to see the definition of mass detonation in Chapter 2.1 of the Model Regulations. More correctly, it should instruct readers to see the definition of mass detonation in the Glossary in Appendix B of the Model Regulations. The procedures (16.4.1.3.1) states "The test is applied to packages of explosive substances and articles in the condition and form in which they are offered for transport." For packages that do not contain a means of explosives initiation or ignition, it is not correct to state that the packages are in the condition and form in which they are offered for transport because the packaging is modified to accommodate a detonator or igniter that is not present during normal transport. Suggest adding a sentence to follow the one referenced above: "For packages that do not contain a means of initiation or ignition, the packages are modified to accommodate a means of initiation or ignition."						

UN Test Series 6 Review
Survey Results
TS 6(a)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
2. The procedures (16.4.1.3.1) states "The test is applied to packages of explosive substances and articles in the condition and form in which they are offered for transport." For packages that do not contain a means of explosives initiation or ignition, it is not correct to state that the packages are in the condition and form in which they are offered for transport because the packaging is modified to accommodate a detonator or igniter that is not present during normal transport. Suggest adding a sentence to follow the one referenced above: "For packages that do not contain a means of initiation or ignition, the packages are modified to accommodate a means of initiation or ignition."						
Point 16.2.2 Waiving of test 6(b) should be extended to test 6(d) Test 6(a) to be in 3 different orientations						
The requirement for the 6(a) test should be removed if the explosive passes the 6(d) test. -Unless there is a compelling and substantial technical reason to the contrary, consideration should be given to removing the requirement for the 6(a) if the explosive test passes the 6(b) test, especially if a low number of items exploded, and the overall effect passes the 6(a) test criteria. Please see additional general comments in our attached letter.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
1. Is the purpose of the 6(b) test adequately defined?	21	72%	8	28%	29	
"Explosion" could be communicated without the result being 1.1 - perhaps better wording here What is an explosion in the context of this instruction? Perhaps it's explained elsewhere. For IM/HC we don't use a word like explosion as it can have many different meanings. What is a mass explosion? Is it "mass" if some some of the material or some of the items "explode"? Or, does it require an "explosion" of all the material.						
Where "mass explosion" can now be assessed, that term is not included.						
Yes but the assessment criteria 'explosion' is not robustly defined						
Para 16.5 .1.1 "introduction" should be changed to "Purpose", and the words mass explosion changed and/or defined. Rationale The words "determine whether an explosion is propagated from one package to another" are not determinable. Normally when a package explodes the neighboring like packages are thrown about and destroyed and sometimes energetic material in the acceptor article react by burning, deflagration, but will seldom explode(sub-detonatively). The phenomenon that propagates in mass for a donor packaged substance/article to like acceptors is known a the detonation phenomenon. Note for consideration: It would benefit all nations if the Orange Book would adopt the definitions for words and phrases used by NATO to describe various reactions that energetic substances and devices containing energetics can exhibit when subjected to various stimulus. Here the words detonation, and explosion are properly distinguished.						
There needs to be a maximum size package or Net Explosive Weight for an individual package. Perhaps the 110 gal non-bulk packaging limit.						
The stated purpose is to determine if there is propagation of explosion from package to package, but why would you proceed to this test if the product has already been found to be 1.1 in the 6(a) test?						
The current purpose is not consistent with the stated criteria and method of assessing results (16.5.1.8). While defining the purpose better would help clarify the test, our opinion is that whether or not a product explosion propagates from one package to another is not the best determining factor to help define the hazard level of the product, as it does not determine the severity of the explosion.						
What is the criteria for blast measurement? Distance and overpressure?						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
2. Are the materials needed to perform the 6(b) test adequately described?	20	71%	8	29%	28	
confining material should be described elsewhere in the document as inert material (non-contributing); if not, then a specific description of 'confining material' should be provided in 6(b) language.						
the quantity of material is not clear. If I have packaged propellant for example, do I test 0.15m3 of packages or 0.15m3 of powder?						
Yes, the need to use a standard detonator.						
16.5.1.2 Need "or" between a & b to help clarify that both the detonator and igniter are not used but one "or" the other only.						
More definition is needed on confining material (as well as "surrounded"). How confining should it be? As written it allows too much variability.						
The test should be recorded on video.						
16.5.1.2 "Blast measuring equipment may be used." Can you give examples of what equipment could be used, without making it prescriptive?						
The list of materials reads as though a detonator AND an igniter will be needed. In reality it will be one OR the other. Suggest a) and b) of para 16.4.1.2 are amalgamated to indicate one or the other is used.						
The result of the test is often contingent on the degree of confinement. The description allows a broad latitude in the type of confinement used and will result in variable results. The detonator is specified as a "UN detonator". Detonators meeting the exact UN definition are impossible to obtain.						
3. When preparing to perform the 6(b) test, is it clear when to use a detonator and when to use an igniter?	20	77%	6	23%	26	
It is to me						
Actually, it is well defined, but we are aware of instances recently where CAs are requiring use of detonators on devices clearly intended to be initiated by igniters. Although this is within their prerogative, there is no guidance on how to interpret results of such tests.						
See above explanation (3rd comment in #2). (not sure when (c) applies)						
My assumption is that an igniter is used if it's a material that's intended to have a burning reaction versus a detonation. But, most such materials will not "explode" even if confined (unless the confinement is too great and the confinement over-pressurizes. And, if it's a package with multiple items it seems only a single item is "ignited". If another item ignites due to the confinement of the exhaust gases is that a "mass explosion"?						
Describe igniter and detonator, specify the use of elec or non elc dets.						
It should be better assigned when we have to use detonator and when igniter, specially if the whole munitions includes different components like high explosive or propellant.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
When per the Test Series 6 introductory paragraph the overarching goal is to determine which hazard division and compatibility group in Class 1 most closely corresponds to the behavior of a load that becomes involved in a fire or an explosion, how the explosive is intended to be functioned is irrelevant because the articles will be subjected to whatever stimuli a mishap generates. And whereas such mishap severity is unpredictable, shouldn't we always be favoring some appropriate conservatism in our assessment of a load's potential misbehavior by insulting our donor with a detonator in at least one trial? For all packaged substances, both a detonator and an igniter should be used (on separate trials). For articles where propellant poses the predominant hazard, is own means of initiation appropriate for all? An initiation sources capable of stimulating the donor in excess of its own means should be considered (e.g. detonator, shaped charge).						
Igniter vs. detonator is currently dependant on intended design. It may be useful to revisit this approach with the goal of ensuring the proper hazard classification for transportation and to ensure that the test criteria continue to provide classifications consistent with the Model Regulations' Hazard Class/Division definitions.						
Paragraph 16.5.1.4(c) says to use a detonator if you obtained a "+" in the 6(a) test. By the text, there is no "+" outcome in the 6(a) test. I presume that "mass explosion" was intended. Why would you be doing this test if you had a "mass explosion" in the 6(a) test?						
4. The test description calls for 3mm mild steel. Should a tolerance for the thickness be provided?	9	35%	17	65%	26	
Perhaps. I would be happy with a "nominal thickness" of 3 mm and I don't know what sort of tolerances there are for steel plate. It is too easy to allow +/- 10% without really knowing what the normal variations are.						
All manufacturing plans allow for tolerances, so it seems reasonable that tolerances for the thickness of the witness plate should be developed. Maybe +/- 0.5mm?						
But, I would do this only if the rest of the procedure is tightened up. And, I'm not even sure the 3mm would be appropriate for all munition types. Is it supposed to replicate some structure that could be damaged in this "mass explosion"?						
Instead of a tolerance, the capability to use different thicknesses and different materials based on the item you're testing should be included. One size may not fit all. An appropriate witness plate for a 155mm HE projectile may not be right for blasting caps.						
1) A tolerance that includes 0.125" (1/8 in.) should be provided since 3mm steel can be a difficult spec to find in the US.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
2) In the US, standard steel sheets are designated by gauges. An 11 gauge steel call out corresponds to a thickness of 0.1196 (+/- 0.008). This equates to a 3.04 mm thick plate. The 3 mm requirement would fall within the manufacturing tolerances of this sheet which equate to a range of 2.83 mm to 3.24 mm. The next thinnest gauge available is 12 gauge which corresponds to a thickness of 0.1046 inches (+/- 0.008). This equates to a thickness of 2.66 mm which could be used and would be significantly more conservative. A tolerance on the thickness would allow for the use of 11 gauge material which, in our opinion would be acceptable thickness. 3) If there is a tolerance it should be wide (~0.5mm), since mild plate steel can vary in both thickness and strength. A tolerance would take into account the inherent tolerances already introduced by the manufacturing process. 4) If there is a need to tighten the test, better defining "damage" to the witness plate and "disruption" of confining materials are more viable issues to address.						
Generally, some tolerance should be provided for any dimensional specifications.						
Yes; ± 0.5mm to permit use of imperial-sized materials. Suggest specifying CR4 grade or similar.						
If 3.0±0.5 mm is implied there is no problem (see preamble of the UN Recommendations). But if an ISO or equivalent standard is implied, the product may be difficult or expensive to obtain. There would be no benefit to a tighter tolerance on the steel thickness in this test. For clarity, the tolerance should be specified in the test description.						
Today the thickness is 3 mm so it could go from 2.6 to 3.4 mm, i think this cap is to important. A thickness of 3+/-0.1 mm should be more precise and not so difficult to obtain for a steel plate.						
Always good practice to quote a tolerance						
This question is irrelevant. Such test is not suitable for a round robin test, where test conditions have to be specified to every detail. The specification is “technical”. Valid results can be achieved with deviating thickness.						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. Please see additional comments in our attached letter.						
5. Should other materials be considered for the witness plate?	4	15%	22	85%	26	
Such as?						
No good answer to this. If the idea is to have a consistent test for comparison purposes, then a single material should be specified, and mild steel is not a bad choice. If the idea is to somehow replicate some structure, then there might be a better choice.						
Also aluminium or some fibre materials may be used, specially for small calliber product.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Instead of a tolerance, the capability to use different thicknesses and different materials based on the item you're testing should be included. One size may not fit all. An appropriate witness plate for a 155mm HE projectile may not be right for blasting caps.						
Possibly a thinner plate should be used. There is an inconsistency within the test series for determining candidates for less than HC/D 1.1 materials. Series 5a test uses a 1 mm steel plate. If the substance fails this test it stays in HC/D 1.1 realm. However, non-blasting agents/substances (which actually may be easier to ignite) use a 3mm plate in the 6a test.						
A single material with a tight specification should be used so that data from all test labs are comparable.						
The current witness plate is sufficient to determine if there is mass explosion.						
Additional information to give guidance to those who have to acquire the witness plate material should be given, in terms of an acceptable range of properties, list of applicable standards and/or specifications, etc. Please see additional comments in our attached letter.						
6. Are there any 6(b) test specifications that could be better defined?	6	25%	18	75%	24	
Emphasis needs to be better on what this test is about and what is a failure. A failure is communication from package-to-package, not simply occurrence of one of the example events.						
For articles, this test requires an item near the center of the package to be functioned. Is this always the best location for the donor? Shouldn't the donor location be the one that gives the maximum probability of propagation and the worse case effects external to the package? If one location doesn't fulfill both of these conditions, then the location could change among the test iterations. I'd also recommend that one of the iterations be conducted unconfined to better evaluate effects external to the packages.						
16.5.1.4(c) "gave a '+' result..." Please use the word positive, instead of this plus sign. It is pretty vague, particularly to non-native English users.						
Mild steel covers a wide range of specifications. Suggest tightening this.						
The result of the test is often contingent on the degree of confinement. The description allows a broad latitude in the type of confinement used and will result in variable results. The detonator is specified as a "UN detonator". Detonators meeting the exact UN definition are impossible to obtain.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Disruption and scattering of the confining material is included in the method of assessing results (16.5.1.8), yet the confining material type and amount is not specified well enough to assure that they will not affect the amount of disruption and scattering. It is helpful that the method of assessing results states "violent disruption and scattering . . ." but the amount of disruption and scattering still depends on the type and amount of confining material. Either the confining material should be better defined, assessment of disruption and scattering should be better defined, or disruption and scattering of confining material should be removed as a method of assessing results.						
7. Are there any tolerances associated with the 6(b) test specifications that could be better defined?	7	27%	19	73%	26	
there should be no tolerance for thickness, and recommend a standard hardness parameter be included in the language.						
As per comments for the 6(a) test regarding "3.0mm" Its a minor point but some of the other tests define what an acceptor is where the term is included - e.g. Series 7 & 8 (b)						
If 3.0±0.5 mm is implied there is no problem (see preamble of the UN Recommendations). But if an ISO or equivalent standard is implied, the product may be difficult or expensive to obtain. There would be no benefit to a tighter tolerance on the steel thickness in this test. For clarity, the tolerance should be specified in the test description.						
Disruption and scattering of the confining material is included in the method of assessing results (16.5.1.8), yet the confining material type and amount is not specified well enough to assure that they will not affect the amount of disruption and scattering. It is helpful that the method of assessing results states "violent disruption and scattering . . ." but the amount of disruption and scattering still depends on the type and amount of confining material. Either the confining material should be better defined, assessment of disruption and scattering should be better defined, or disruption and scattering of confining material should be removed as a method of assessing results.						
It could be better to defined more precisely the sand used for the confinement => the maximum grain size)						
Always good practice to quote a tolerance						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. Please see additional comments in our attached letter.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
8. Are there any unnecessary or over-specifications in the 6(b) test?	5	20%	20	80%	25	
In certain circumstances, 6D test results could be used in replacement for 6B if there is no mass detonation and effects outside the package are limited.						
Just the tendency to misapply the results in determining if mass explosion has occurred. See 1st comment under #6 above.						
The procedure (16.5.1.3) requires a total volume of 0.15 cu. m. of packages for the test. The volume as specified is too specific. The value of 0.15 cu. m. is stated without basis, and may be unnecessary.						
The minimum volume of 0.15m cube should be removed. The test is to determine if propagation from "one package to another" will take place. The test box is surrounded by boxes with the same explosive product. This will identify if cross propagation takes place.						
The requirement that enough packages are required to give a total volume of 0.15 m appears to be arbitrary and could be problematic in certain instances. Please see additional comments and explanation in our attached letter.						
9. Are the assessment criteria that are used to distinguish between different explosive Divisions adequately defined?	16	59%	11	41%	27	
The criteria seem to be more defined and more strict than the 6a test - could be more consistent.						
I have done some 6b tests and had little difficulty with them.						
So long as the criteria aren't overly interpreted or misinterpreted.						
What are the definitions for "appreciably" and "significantly"? Is that double, or 50% more, or 10% more? You will disrupt the confining material just from the reaction of the donor.						
IM-tests and test for transport should be harmonized within some time.						
The violent disruption and scattering of most of the confining material criterion is not necessarily indicative of HD 1.1. For large articles (e.g. missiles, bombs) this could have been caused by the intentional function of the donor article. With the current procedure of three confined tests, comparing the measured blast to a single article could be misleading. Changing one of the tests to unconfined (as proposed above) and using the blast measurements from that test for comparison would be appropriate. Projections should be mapped and used along with the external fire test data to determine the HD.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
16.5.1.8(a), (b), and (d) are clear. However, 16.5.1.8(c) is too vague - "measurement of a blast which significantly exceeds that from a single package or unpackaged article". First issue is that 16.5.1.2 and 16.4.1.2 state that blast equipment MAY be used. If it is not used, how can you measure any blast or compare to the single package test? In addition, blast is not defined and substances and articles with a "minor blast" can be classified as 1.3 [UN Model Regulations, 2.1.1.4(c)]. Please identify a measurable threshold between minor and major blasts, or define its effects (e.g. debris scattered x meters from package). Also, what does "significantly exceeds" mean? Of course several packages of something that blasts are going to have a bigger blast than a single package. Are you talking about synergistic effects?						
1) Define what a crater is (diameter/depth of hole). Ground conditions may affect whether a crater is formed. 2) the criteria is "mass explosion". To help aid in this, define what is meant by "disruption and scattering of the confining material". Is "disruption" ok as long as "scattering" does not occur? "Heaving" or "sluffing" of the confining material do not seem to explain a "mass explosion". This example of mass of explosion could be better defined. 3) The criteria "damage to the witness plate" provides a wide range of interpretation. What is "damage"? any slight discoloration? bowing? well defined indentation? perforation of any degree? or only a definite hole? size of hole or dent? 4)The criteria "disruption of confining material" provides a wide range of interpretation. How much disruption is allowed? how much is too much? How to define for propellant or smokeless powder or grenade which needs to vent (disrupts sand) yet clearly has no crater? 5) Quantifying percentage of recoverable vs. percentage which functioned- Define "mass detonation" units damaged by pressure wave, not sympathetic detonation. 6) Each product dependent on design has critical parameters that override other keys. 7) MTC is technical manual written to generically address majority of explosive materials and devices. However, it is a guideline which should allow labs to discern which critical parameters are crucial for any given substance/article.						
The 6(b) test essentially assesses whether the material is a candidate for a 1.1 classification; it doesn't assign into other Divisions at this stage. The 6(c) test is the primary test for assigning Division.						
Note that the stated purpose is to determine package to package, or unpackaged article to unpackaged article propagation of explosion.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The criteria are fuzzy for the same reasons as given for the the 6(a) test.						
Observations are suggested (16.5.1.7) for thermal effects, projection effects, detonation and deflagration without guidance for evaluation as evidence of propagation of an explosion from one package to another. These observations are not included in the test criteria (16.5.1.8) for assessing results, leaving it unclear as to how to apply the observations to the assessment of propagation from one package to another. (2) Explosion or damage to explosive articles in the package other than the one intentionally functioned are not included in the test criteria and method of assessing results (16.5.1.8) for evidence of propagation of explosion from one package to another, yet are commonly used for that purpose. It is suggested that they be included, with guidance for assessing results as related to evidence of propagation.						
Should be a better way of defining whether more than one package has initiated						
10. Use the space below to provide any other comments about the 6(b) test.						
Why are some articles which have no characteristics of a mass explosion subject to the 6(a) test just because they must pass the series 6 testing. Some way of opting out should be allowed or stated.						
Like in the 6(a) test, I have a problem with confinement. As already noted, it's just too variable as now "specified". In some cases it has been extreme - burial in sand. It that's done it hinders our ability to assess the reaction. But, more importantly, it could get test operators killed. If a single item is tested, we are fairly safe to assume that we initiated that item and it reacted. However, if there are multiple items in the package how can you tell exactly what has reacted under the sand? Is there damaged energetics, perhaps even cooking off? Have safety devices been compromised? I'm sorry, but I hate this test as currently run. But, in this case, we plan to have "unreacted" material left over. It's even worse.						
For military munitions, using the stack test only for assessing for mass explosion and then, if not 1.1, classing based on the fire test results is no longer viable---unless you believe that numerous large high explosive bombs and warheads belong in 1.3 and 1.4. They must be 1.2 at a minimum from my perspective. The cause for the above is the past 30 years or so of technology development towards "insensitive munitions." Through success down that path, an explosion is no longer propagated from one package to another of many high explosive or detonable configurations, and in fire testing those configurations only burn.						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
So to preclude 1.3 and 1.4 assignments of those high explosive and detonable configurations, the output of the donor and any acceptors violently reacting in the stack test must be what qualifies the article for 1.2 (or 1.1 if most acceptors present promptly detonate with the donor). One stack test trial needs to be conducted unconfined so that the mass-distance relationship curve normally applicable for fire testing can be utilized to assess whether the projections generated exceed 20J or not.						
The 6b test seems redundant since worst case would be 6a in intimate contact: Fail 6a --> 6b is waived and classification is 1.1 Pass 6a --> if items are packed in intimate contact within package and no propagation, proceed to 6c. items packed in intimate contact within package.						
Again, introducing some screening procedure before test series 6 may be preferable.						
If an article fails to propagate to others within a package during the 6(a) test, is it necessary to also carry out a 6(b) test? It is highly unlikely that an item which doesn't propagate to other items within a package, will then go on to propagate between adjacent packages. When testing packages containing only one article, we are often required to carry out one of the three 6(b) tests in an unconfined condition, by our customer (US DOD). This is to assess the degree of package disruption in a similar way to the 6(d) test, even though we may not be seeking a 1.4S classification. Could this be a useful aspect to the testing?						
The rationale for this test should be more clearly stated that greater quantities of sample and greater confinement are more likely to lead to a mass explosion. It should more clearly stated that it should be applied to samples that do not mass explode in the 6(a) test but react sufficiently violently to breach their packagings in the 6(a) test, or cause their packagings to burn in the 6(a) test.						
The procedures (16.5.1.3) states "The test is applied to a stack of packages of an explosive product or a stack of unpackaged articles, in each case, in the condition and form in which they are offered for transport." For packages that do not contain a means of explosives initiation or ignition, it is not correct to state that the packages are in the condition and form in which they are offered for transport because the packaging is modified to accommodate a detonator or igniter that is not present during normal transport. Suggest adding a sentence to follow the one referenced above: "For packages that do not contain a means of initiation or ignition, the packages are modified to accommodate a means of initiation or ignition."						

UN Test Series 6 Review
Survey Results
TS 6(b)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The requirement for the 6(b) test should be removed if the explosive passes the 6(d) test. Unless there is a compelling and substantial technical reason to the contrary, consideration should be given to removing the requirement for the 6(a) test if the explosive test passes the 6(b) test, especially if a low number of items exploded, and the overall effect passes the 6(a) test criteria as well. Please see additional general comments in our attached						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
1. Is the purpose of the 6(c) test adequately defined?	26	90%	3	10%	29	
the sentence as written is ambiguous because of how the term hazard is used; recommend reconstruct the sentence so it is more clear that the hazard the test is undertaken to determine is the unwanted presence of the test item / test item constituent and not the unwanted presence of ambient / environment on the test item						
What is a mass explosion?						
The purpose includes determination of "other dangerous effect when involved in a fire," without defining what is meant by other dangerous effect, and without including assessment of other dangerous effects in the criteria and method of assessing results (16.6.1.4).						
2. Are the materials needed to perform the 6(c) test adequately described?	21	75%	7	25%	28	
The main issue is mesh size of the metal grid on which the This issue is disadvantaging Orica because the Canadian Authorities declare the test void if product falls into the mass of burning wood and is 'contained' by it, whereas Authorities in some other countries ignore this effect and will grant a 'pass' to product which would clearly fail were it kept above the fire.						
the quantity of material is not clear. If I have packaged propellant for example, do I test 0.15m3 of packages or 0.15m3 of powder?						
Strapping-why allowed-could affect the test results to better the outcome. When might this be applied?						
But, if the fire is strong enough in one direction, might not an aluminum panel melt, destroying evidence of fragment impacts?						
Metal grid must be sufficiently above the height of the selected fuel to allow proper mixing of air into the flame/fire prior to reaching the test material. Fuel supply: Using a wood (stacked boards, not pallets) or liquid fuel fire, most of the material is consumed or reacted within 15 minutes of starting the fire. The currently described wood fire set up lasts only about 10-15 minutes. A 20 minute fire is usually more than adequate.						
There are other burning materials usable to create a bonfire.						
Only regarding the Al test screens there should be a revised specification, perhaps based on a punch-test.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
3. The test description calls aluminum witness panels that are for 2000 mm x 2000 mm x 2 mm. Should tolerances for the witness panel size be provided?	12	44%	15	56%	27	
Dimensions are OK but witness panels should extend closer to the ground (distance to be defined). Currently there is no specification for the maximum distance of the panel from the ground. The issue is that projectiles can pass below the panel and thus 'pass' a product which falls through the grid, into the fire, and detonates on the ground or close to it.						
it should be made clearer that aluminium with different properties may be used if the results can still be interpreted.						
Witness panel description in the procedure is pretty well done. However, some reasonable tolerances should be established for panel size.						
They should only be provided if 1) any variance from those exact dimensions would result in a "no test" ruling or 2) dimension differences would affect the test results. In some cases, they might. If tolerances are given, they need to make sense - not like the too strict tolerance on bullet velocity for the BI test.						
Depending on the wind conditions during test, witness plates some times simply melt down. Alternative materials could be adequate.						
An option to eliminate the witness panels and collect projections should be added. The witness panels can block video views. And they are not calibrated to tell you what the depth of dents from strikes by plastic, wooden, rubber, etc. projections mean.						
Think the hardness and tensile specifications would keep wide variations from the nominal dimensions from occurring.						
Tolerances could be used to make it possible to buy panels based on the inch system.						
The witness panel of this dimensional specification is not available in Japan. Some tolerance of dimensions should be provided.						
Sheets of this size are expensive to procure (especially if they need mm tolerances are important. 2000 x 2000 +/- 5mm would be fair. Stating a maximum thickness of 2mm with a tolerance would be pragmatic.						
By the UN Recommendations' preamble, ±0.5 mm is implied. This is clearly unreasonable. The edge length tolerances should be in the order of ±100 mm. The thickness tolerance should be set so that common manufactured gauge thicknesses, in all parts of the world, of aluminium sheeting are included.						
Tolerances not needed, and would overspecify the material.						
Today the thickness is 2 mm so it could go from 1.6 to 2.4 mm, i think this cap is to important. A thickness of 2+/-0.1 mm should be more precise and not so difficult to obtain.						
Tolerances are good practice						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. The 2000 mm x 2000 mm should be described as a minimum area, allowing for larger panels to be used electively if desired. Please see additional comments in our attached letter.						
4. Should other materials be considered for the witness panels?	7	25%	21	75%	28	
The specification states "or equivalent". That should be adequate.						
Only if there is a concern as I noted on the aluminum melting.						
Depending on the wind conditions during test, witness plates some times simply melt down. Steel would probably withstand this better.						
Additional witness panels should be used to help determine the response level of the articles. The optimum material to use for a witness plate depends on the type and velocity of the expected fragments. For heavy articles with steel walls, a steel witness plate with a thickness of at least 25 mm is recommended. Normally, witness plates should not be in direct contact with the test item since this might alter the heat flow into the round and the confinement of the energetic material. Ideally, there should be at least 200mm between the witness plate and the test munition so as not to interfere with the uniform heating of the munition.						
Possibly. The failure criteria based on witness panels and the fragment mass/distance relationship should match. At times it appears that they do not. In addition, the 1100-0 aluminum (pure aluminum) is hard to find. A modern alloy with the appropriate thickness should be identified.						
Including provision for sheets of mild steel (including galvanized to allow designers to build in better durability/weatherability of the test area) would be useful for saving cost where frequent witness panel changes become necessary. Although provision is made for equivalent an additional defined alternative material would help without having to go down the route for materials testing prior to setting your test site up.						
In the past it has been very difficult to obtain the correct specification of aluminium sheets; offer an alternative material specification which is more readily obtainable.						
Although aluminium sheets are handy to use, denting and perforation may not be as regular and measurable as desirable. Fragment traps composed of layers of various materials would be easier to assess and would better measure kinetic energy and velocity.						
Other methods of determining projection energy level should be considered. It has not been established that aluminum panels result in consistent results for varying projectile shapes.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The type of aluminum specified is difficult to find and appears to be on the edges of commercial availability in the USA. Alternatives should be provided. Please see additional comments and explanation in our attached letter.						
5. Are there any 6(c) test specifications that could be better defined?	8	30%	19	70%	27	
The importance of the total volume (minimum of 0.15 m3) is not always well understood. If fewer products are used it increases the likelihood of not having any perforation / indentation on witness panels.						
the test temperature of at least 800 C needs clarification. does it have to be above 800 for the entire time? Perhaps the 800 only applies to liquid or gas fires? that could be made clearer.						
Additional information on the equipment and procedures used to measure thermal flux would be beneficial.						
1. There is no mention of use of thermocouples for flame temperature measurement or where this should be measured (propose it is at the article) 2. Whether the 800DegC is an appropriate value and whether this should be a minimum or average temperature (suggest an average is specified) after an induction period.						
16.6.1.2 "Blast gauges,..." be noted as step (i) under this section? 16.6.1.3.1 "encircled with a steel strip" we use the term steel strap in the US and strip implies weak tensile strength - is strip a more European term? "a flame temperature of at least 800 degrees C" how long does this temperature need to be maintained - the whole 30 minutes? 10 minutes? a brief spike anytime in the test?16.6.1.4.4(c) should refer to Table 16.2						
16.6.1.2. - What constitutes a high speed video camera? (e.g. 60fps could be considered adequately high speed when choosing a consumer camera to film the effects expected with a 1.3G or 1.4G result (to catch projections on film). but this definition is too loose - some would consider high speed to be 2000fps so a camera spec would help. 50fps would be a figure that is achievable for modest budgets with semi-pro equipment (e.g. a £1000 camera) and with the evolution of digital video, would it be appropriate to specify a quality level or at least include guidance e.g.. 720p@50fps has proved to be adequate based on our observations from selecting equipment from our own tests. What's 'cine'?						
Yes - fiery projections.						
Method of constructing the fire should be less specific and focused on what the resultant fire should be (temperature range, need to engulf the packages, etc.). Currently the listing of methods to build the fire is incorrectly taken by some testers to define the only ways that a fire can be built.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Only regarding the Al test screens there should be a revised specification, perhaps based on a punch-test.						
6. Are there any tolerances associated with the 6(c) test specifications that could be better defined?	6	22%	21	78%	27	
The flame temperature						
More details on the heating profile; suggest specifying an average value that is achievable for the fuel sources specified. Also detailing an acceptable induction period.						
16.6.1.3.8 "leaving a significant quantity of unconsumed explosive substance in the remains or in the vicinity of the fire" what is a significant amount - 50% of the NEW in the packages? 30%? 10%?						
Although aluminium sheets are handy to use, denting and perforation may not be as regular and measurable as desirable. Fragment traps composed of layers of various materials would be easier to assess and would better measure kinetic energy and velocity. The Brinell Hardness 23 and tensile strength 90 MPa are specified without tolerances. The alloy is already specified. The chances of getting all three parameters to line up for a particular lot of aluminium are pretty slim. Why is the flame temperature specified? There is not a lot you can do to adjust it. The overall size of the fire is more important than the temperature of flames in an unspecified part of the fire,						
Tolerances are good practice						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. The 2000 mm x 2000 mm should be described as a minimum area, allowing for larger panels to be used electively if desired. Please see additional comments in our attached letter.						
7. Are there any unnecessary or over-specifications in the 6(c) test?	10	37%	17	63%	27	
Only one perforation / indentation on witness panel can result in test failure. It is very severe because witness panels are far from covering the whole volume, passing or failing the test is often a matter of luck.						
fire duration is overspecified. if testing powder and it all burns in 5 minutes, whey do I have to have a fire for 30 minutes? Unfortunately, (because it shouldn't be necessary to spell it out) the wood mass could perhaps be used as a guide to allow different wood configurations. For example, when I used old pallets for the fire, I calculated how much wood was in the model lattice then used that much wood in pallets. When testing propellants, why must the gas fire extend 1 m in all directions?						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
The required minimum burn time is 30 min, this is in the area of twice as much as needed (based on experience). If there was a point describing that the burn time could be decided by the test house, based either on experience from previous tests or calculations, the test houses should be allowed to perform in accordance with this, at their own risk.						
The measurement of thermal flux is not necessary or the measurement is very difficult to do.						
Why is 800degC a necessary temperature when most timber cribs only hit 700degC? Is this for Gas/fuel pyres? When testing with timber, provided the packages are engulfed in flame does it really matter what the temperature is? (cribs made from pallets can sometimes come in less than 800degC, but still result in a thorough burn.						
For the wood fire - can alternatives to the very expensive kiln-dried wood, such as pallets, be used? The caveat would have to be that the intensity and burning time of the fire can be achieved for an adequate test result.						
The Brinell Hardness 23 and tensile strength 90 MPa are specified without tolerances. The alloy is already specified. The chances of getting all three parameters to line up for a particular lot of aluminium are pretty slim. Why is the flame temperature specified? There is not a lot you can do to adjust it. The overall size of the fire is more important than the temperature of flames in an unspecified part of the fire,						
16.6.1.2 requires a total volume of packages or substances or articles to be not less than 0.15 cu. m. Volume is not necessarily the determining factor for resultant hazardous effects in a fire, and no basis is given for this minimum volume. (2) Metal grid to support packages in fire is over-specified. (3) In the procedure, the example methods to construct a fire require at least one meter of fuel beyond the packages. This over-specifies the requirement of 16.6.1.3.1 that the fire engulf the packages. (4) 16.6.1.3.6 states that tests should not be performed where the wind speed exceeds 6 m/s, without giving a basis for that requirment, and with disregard for the requirement that the packages be engulfed in flame that would seem to make the wind speed requirement unnecessary.						
16.6.1.2 Point(g) : Hardness and Tensile strength values be made nominal values only as the Al condition is already defined 1100-0						
The requirement that enough packages are required to give a total volume of 0.15 m appears to be arbitrary and could be problematic in certain instances. Please see additional comments and explanation in our attached letter.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
8. Are the assessment criteria that are used to distinguish between different explosive Divisions adequately defined?	16	53%	14	47%	30	
"Mass explosion" not well defined						
some thoughts and observations:						
fireball or jet of flame beyond the witness screens can be hard to assess of the jet is small.						
16.6.1.4.5.e is very hard to calculate for packages of propellants. And I found the scaling calculations to be impossible to follow.						
Division 1.1 - what is a mass explosion? How is that determined? Division 1.2 – how are you going to determine if the kinetic energy is greater than 20 J? Division 1.3 – what if the fireball or jet of flames hits the witness screen and so can' extend beyond it? Would not the irradiance be a function of the material as well as the severity? Division 1.4 other than S – where does the 4 mm value come from? How would you determine if the KE > 8 J? Division 1.4S – How can someone possibly determine if a thermal, blast, or projection effect would significantly hinder firefighting or other emergency response efforts in the immediate vicinity? What's "immediate vicinity"?						
For the 1.4S criteria, what is considered a hazardous effect that needs to be confined within the package? The other criterion implies that you can have some thermal, blast, or projection effects outside of the package (provided they don't hinder firefighter or emergency response efforts), so what hazardous effects or what level of hazardous effects need to be contained? What is considered to be the immediate vicinity?						
Suggest that some improved response descriptors would help with the consistency of assigning the hazard classification. Those used in UN TS7 are again suggested.						
The discrimination between 1.1 and 1.2 using 'mass explosion' or 'a substantial proportion explodes' is difficult to work with and is likely to lead to differences in classification between national authorities.						
Perhaps a good discriminator would be UN TS7 response descriptors for detonation, partial detonation, and explosion response lead to HD 1.1.						
For HD 1.2 this would correspond to the deflagration response level.						

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Logically 1.3 would then correspond to burning response. However, the current criteria include 'fiery projection' which are generally accepted to include articles projected by burning propellant under the current definition. It is entirely possible that these would have a mass and velocity equating to a kinetic energy in excess of the 20J criteria which should precluding entrance into 1.3 accordingly. Perhaps it might be acceptable to add some words to account for intact articles containing a propulsion component which could be expected to leave the test site.						
16.6.1.4.4(c) and 16.6.1.4.5(e) "a burning time of the product measured..." we have no way to measure how long it took the article or substance packaged inside containers to burn. We can only measure the quantity of NEW in the package before the burn and NEW that may be remaining in the packages after the external fire test is complete, the cans have had time to cool, and a safety period of 24 hours has elapsed and we open the container to examine the remains. There is no way to determine whether the explosive burned off in the first few minutes or it took the entire 30 minutes or so of the burn. How do you intend this to be measured? Any instrumentation inside the package would negate the intent of testing the packages as they would be configured for shipment.						
1) The allowed wind speed may affect how far out a fireball travels. Fireballs that may extend beyond the screen when running tests with a wind (up to 6 m/s), may not have such an effect when the test is run with no wind. Compensation of the wind should be discussed when assessing the fireballs. 2) Define fireball/jet/flame, fiery projection, and metallic projection. Each of these 3 has a clearly defined distance allowable (with different distances for each). How to discern between the effects is not always clear. (see #4) 3) a) Division 1.2- what happens if testing large quantity of units and not recovering items for weight? Can this be ruled out in the calculation of 20J for max distance? Projections can easily exceed tested area for articles designed to perform this way. b) Division 1.3- difference between "fiery projection" (15m) from the package vs. "fireball or jet flame" (4m, past the witness screen) seems contradictory. What is the criteria for evaluating fireballs or jets which do not pass the witness screen but exceed 4m in a vertical or angled direction?						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
c) Division 1.4- differences of fireball/jet of flame or fiery projection, or metallic projection (Question 3 above). Items not recovered- how can they be ruled out in 8J equation (assuming you cannot locate articles exceeding test area). d) 1.4S- "not hindering fire fighters and first responders" is vague. How does 8J limit/equation relate to first responders? 4) Appears to be a broad variety of interpretation in calculation of burning time and thermal flux evaluation. Note 3 of Section 16.6.1.4.8 refers to "separate events" to be measured, if possible. If not possible, however, is the calculation useful at all? Would it be possible to measure burn time on a single inner packaging and scale up the results?						
For 1.1 to 1.4 excluding compatibility group S the definitions are clear, but for 1.4S, what would be considered a hazardous effect for determination of whether or not its confined to the package?						
For a 1.4S classification to be awarded, one of the conditions of the 6(c) test to be met is that the hazardous effects are to be confined within the package; how does that work with a fibreboard or wooden box, which is quickly consumed in the fire?						
16.6.1.4.2 states that if mass explosion occurs then the product is assigned to Division 1.1. Depending on the severity of the explosion and subsequent hazard level, this may be an inappropriate assignment. 2. 16.6.1.4.3(b) specifies projection kinetic energy of less than 20J. What is the basis for this requirement? Is it, or should it be directional (is the hazard level the same in all directions)? 3. 16.6.1.4.4(c) states requirment for burning time of a product. What is the basis for those requirements? 4. 16.6.1.4.5(a) includes specifications for a jet of flame. For clarity, suggest that the statement be "a fireball or jet of flame emanating from the packages or product ..." to distinguish events from the fuel or fire itself. 5. 16.6.1.4.5(c) includes the criteria of no indention in the aluminum witness screens of more than 4 mm. What is the basis for this requirement? Is this depth, or length/width?						

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
6. 16.6.1.4.5(d) includes the criteria of no projection kinetic energy exceeding 8 J. What is the basis for this requirement? Is it , or should it be directional (is the hazard level the same in all directions)? 7. 16.6.1.4.5(e) includes burning time criteria. What is the basis for this requirement? 8. 16.6.1.4.6 - Define "effects that would not significantly hinder fire-fighting or other emergency response efforts in the immediate area." 9. 16.6.1.4.6 - Requires hazardous effects to be confined within the package. In a fire, some types of packaging will burn. How does one tell if hazardous effects have been contained within burned packaging? 10. 16.6.1.4.6 - Requires hazardous effects to be confined within the package. This requirement is overly restrictive - many non-explosive consumer products cannot meet this criteria. 11. What is the basis for the distance-mass relationships of Figure 16.6.1.1?						
Some of the criteria seem arbitrary in terms of projections and size and extent of fireballs etc						
Figure 16.6.1.1 The measured values of distance or mass that are lying on the curves (or alongside) are uncertain (measurement uncertainty) for their assessment in respect of the correct Division. And therefore the competent authority has to assign the article on the own experiences. The distance and mass scale for article 1.4S and 1.4 is unproportional. The graduation per 100 grams / 10 m is very large for assessment of test results.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
9. Use the space below to provide any other comments about the 6(c) test.						
The main issue remains the decision made by some Authorities to waive the test and approve 1.4 hazard classification by analogy. In particular, the type of projection from copper and copper alloy detonators is not well understood and leads to improper 1.4 classification. It is hard to believe that full strength copper detonators without base charge protection can be granted a 1.4B or 1.4S hazard classification if the 6(c) test is performed correctly. It is very hard to assess " a fireball or jet of flame which extends more than 1 m from the flames of the fire". The following needs a better definition and a method to measure: "an indentation in any of the witness screens of more than 4mm": in which direction do you measure and how? Where is says: " a metallic projection with a kinetic energy of..." if what is projected is an assembly with metal parts (i.e. an attenuator + wire + detonator), what do you measure?, would it be considered a metallic projection?						
16.6.1.2 The device used to determine outcome of 16.6.1.4.4(c) should be specked out and described in this section. Previous experience has shown that most radiometers are not affective for continuous use. 16.6.1.4.5 Distance isn't defined but mass and energy only. Where did 4 m come from for a distance when it should be driven by the mass energy table. Nothing stated about Class 9 only "out of Class 1". Needs to be more specific to encompass Class 9.						
Bonfire / FCO tests and their outcome and repeatabilty are highly depending on local conditions and weather. Perhaps it could be mentioned, one way or another, that this is a fact, and that results from tests therefore may vary more than expected, even with almost similar test objects and hearths.						
It should be possible to use gas burner instead of liquid fuel and wood to avoid the oil spill in case of explosion.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Previously I've recommended an unconfined single package and stack test. Recommend the assessment criteria for the external fire test be utilized for these unconfined tests as well.						
16.6.1.3.6 - "test should not be performed...wind speed exceeds 6 m/s." Is this speed for the entire test or just at the start of the test? non-flaming gas releases? 16.6.1.4.7(ii) article intended to produce an effect, but has no effect sounds like a dud to me?						
1) Sometimes the 0.15m^3 requirement is cumbersome for customers who sell a small amount of product per year. This requirement can represent more material than they might manufacture in a decade. It would be advantageous to have a way to test less material and perhaps give the company a maximum amount they could ship based on such a test. 2) A test program could be developed where the existing witness screen is subjected to various well defined projectiles (mass, shape, energy at impact) and the damage assessed. Candidate replacement materials could then be subjected to a reduced set of the same tests to determine if it qualifies by providing a similar response.						
Test 6(c) is not suitable for shell fireworks because ignition of one of shells results in a projection of other shells inevitably.						
A diagram to describe 16.6.1.3.5 would be helpful, showing preferred positions of video equipment for evidence gathering.						
The test description suggests that blast gauge and radiometers should be used but gives no guidance at to what specific model should be used, how to set them up, or how to assess the results. The measurements resulting form such devices depend on the type/model of device, their mode of use, and the data treatment. Without a standard procedure, there is no point in using them.						
1. The procedure gives an overview of the test method in 16.6.1.3.1, and then lists three possible methods to construct the fire in 16.6.1.3.2, 16.6.1.3.3 and 16.6.1.3.4. The three possible methods are options for 16.6.1.3.1, and hence should be identified organizationally as 16.6.1.3.1.1, 16.6.1.3.1.2 and 16.6.1.3.1.3 so that they do not appear as additional steps of the procedure. 2. Video cameras should require more than one camera, and cameras should be aimed so that significant events will be recorded sufficient to identify what is happening. 3. Flame temperature of at least 800 degrees C is required, without basis for that minimum and without specifying a procedure to measure the flame temperature.						

UN Test Series 6 Review
Survey Results
TS 6(c)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Testing staff needs experience with tests; tests cannot be done from the handbook alone.						
The description should specifically allow for commonly used, economical wood fuels such as used pallets, provided that they otherwise meet the criteria and there is no compelling and substantial technical reason not to use them. Please see additional comments and explanation in our attached letter.						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
1. Is the purpose of the 6(d) test adequately defined?	26	96%	1	4%	27	
The purpose should be re-worded "This is a test on a single package to determine if there are hazardous effects outside the package arising from intentional ignition or initiation of some of the contents." The test does not determine effects from accidental ignition or initiation. As worded, the purpose seems to imply an analysis of accidental ignition or initiation.						
2. Are the materials needed to perform the 6(d) test adequately described?	24	89%	3	11%	27	
Why is a steel witness plate needed. Shouldn't you be able to determine whether effects are contained in the shipping container by a post test evaluation of the container itself?						
Where possible, initiate using the article's own initiating device. The use of an additional detonator or initiator needs to be quantified and negated for the test result to be representative.						
The list of materials reads as though a detonator AND an igniter will be needed. In reality it will be one OR the other. Suggest a) and b) of para 16.4.1.2 are amalgamated to indicate one or the other is used.						
3. When preparing to perform the 6(d) test, is it clear when to use a detonator and when to use an igniter?	25	93%	2	7%	27	
Actually, it is well defined, but we are aware of instances recently where CAs are requiring use of detonators on devices clearly intended to be initiated by igniters. Although this is within their prerogative, there is no guidance on how to interpret results of such tests.						
Igniter vs. detonator is currently dependant on intended design. It may be useful to revisit this approach with the goal of ensuring the proper hazard classification for transportation and to ensure that the test criteria continue to provide classifications consistent with the Model Regulations' Hazard Class/Division definitions.						
The description needs to expand on the circumstances under which each device may be used.						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
4. The test description calls for 3mm mild steel. Should a tolerance for the thickness be provided?	13	48%	14	52%	27	
steel down to 0 mm should be permitted.						
All manufacturing plans allow for tolerances, so it seems reasonable that tolerances for the thickness of the witness plate should be developed. Maybe +/- 0.5mm?						
A steel plate shouldn't be used if a & c have been performed. Serves no purpose.						
Since the criteria is any dent, the thickness likely doesn't matter.						
The steel witness plate isn't needed. See my comment for question 2. 1) A tolerance that includes 0.125" (1/8 in.) should be provided since 3mm steel can be a difficult spec to find in the US. 2) In the US, standard steel sheets are designated by gauges. An 11 gauge steel call out corresponds to a thickness of 0.1196 (+/- 0.008). This equates to a 3.04 mm thick plate. The 3 mm requirement would fall within the manufacturing tolerances of this sheet which equate to a range of 2.83 mm to 3.24 mm. The next thinnest gauge available is 12 gauge which corresponds to a thickness of 0.1046 inches (+/- 0.008). This equates to a thickness of 2.66 mm which could be used and would be significantly more conservative. A tolerance on the thickness would allow for the use of 11 gauge material which, in our opinion would be acceptable thickness. 3) If there is a tolerance it should be wide (~0.5mm), since mild plate steel can vary in both thickness and strength. A tolerance would take into account the inherent tolerances already introduced by the manufacturing process. 4) If there is a need to tighten the test, better defining "damage" to the witness plate and "disruption" of confining materials are more viable issues to address.						
Generally, some tolerance should be provided for any dimensional specifications.						
Yes; ± 0.5mm to permit use of imperial-sized materials. Suggest specifying CR4 grade or similar.						
If 3.0±0.5 mm is implied there is no problem (see preamble of the UN Recommendations). But if an ISO or equivalent standard is implied, the product may be difficult or expensive to obtain. There would be no benefit to a tighter tolerance on the steel thickness in this test. For clarity, the tolerance should be specified in the test description.						
Since the criteria is indentation of the witness plate, a tolerance is not needed.						
Today the thickness is 3 mm so it could go from 2.6 to 3.4 mm, i think this cap is to important. A thickness of 3+/-0.1 mm should be more precise and not so difficult to obtain for a steel plate.						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
Tolerances are always a good practice						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. Please see additional comments in our attached letter.						
5. Should other materials be considered for the witness panels?	6	22%	21	78%	27	
Any witness plate is redundant. if anything gets outside the package, the material is not 1.4S. why bother with the steel witness plate?						
Shouldn't be used.						
Since the criteria is any dent, the type of material likely doesn't matter.						
The steel witness plate isn't needed. See my comment for question 2.						
A single material with a tight specification should be used so that data from all test labs are comparable.						
Additional information to give guidance to those who have to acquire the witness plate material should be given, in terms of an acceptable range of properties, list of applicable standards and/or specifications, etc. Please see additional comments in our attached						
6. Are there any 6(d) test specifications that could be better defined?	4	15%	23	85%	27	
A flash or flame capable of igniting an adjacent material such as a sheet of 80 ± 3 g/m² paper at a distance of 25 cm from the package. I'm not comfortable with "capable of". Why not just require that piece of paper as part of the test equipment and the criteria is that it doesn't ignite?						
Additional information regarding the placement of the sheet of paper is needed. Should it be surrounding the package or just in the direction you expect flash/flame? For articles, this test requires an item near the center of the package to be functioned. Is this always the best location for the donor? Shouldn't the donor location be the one that gives the maximum probability of propagation and the worse case effects external to the package? If one location doesn't fulfill both of these conditions, then it could change among the test iterations.						
"Video equipment MAY be used" should this be step (d)?						
16.7.1.4 (b) 'Adjacent material such as' ....80gsm paper. Is this an appropriate specification? if accidental ignition has occurred, would it would be more prudent to test against the typical transport packaging material, or is 80gsm paper selected because goods in compatibility group 1.4S can be transported and stored in wider circumstances so a more easily ignited material is deemed appropriate?						
7. Are there any tolerances associated with the 6(d) test specifications that could be better defined?	2	7%	25	93%	27	
steel down to 0 mm should be permitted.						
Either tolerances or a statement that common commercial tolerances are acceptable should be included in all cases. Please see additional comments in our attached						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
8. Are there any unnecessary or over-specifications in the 6(d) test?	2	7%	25	93%	27	
steel down to 0 mm should be permitted.						
16.6.1.2 Point(g) : Hardness and Tensile strength values be made nominal values only as the Al condition is already defined 1100-0						
9. Are the assessment criteria adequately defined?	21	78%	6	22%	27	
Denting or perforation of the witness plate needs better definition. How deep the denting, what about a scratch?						
Quite clear						
We heard of instances where the package exterior was blown away in the test, but all of the contents remained within the area of the confines of the package. Consideration should be given as to what level of blast pressure might be deemed a hazardous effect, and how to measure that.						
A flash or flame capable of igniting an adjacent material such as a sheet of 80 ± 3 g/m² paper at a distance of 25 cm from the package. I'm not comfortable with "capable of". Why not just require that piece of paper as part of the test equipment and the criteria is that it doesn't ignite?						
Eliminate the witness plate criterion. Why is a steel witness plate needed. Shouldn't you be able to determine whether effects are contained in the shipping container by a post test evaluation of the container itself?						
1) It is unclear as to how to classify something in which the tape on the packaging breaks. 2) "Disruption of the package"- Any blast effects that compromises the integrity of the package should also be a basis for failure in the test. 3) Specify that the fire effects at 25 cm are due to reaction of the substance / article, not due to a burning package.						
A relatively violent explosion can blow the packaging apart without producing inert projectiles and without scattering the "explosive contents". It could be argued that the result is 1.4S. The wording should be modified if the packaging should stay intact for the sample to be considered 1.4S. It would be helpful if the document made it clear that reactions that lead to slow quiet burning of a package were not acceptable.						
16.7.1.4(a) - denting should be defined more clearly (is a scratch a dent?). 2. 16.7.1.4(b) - how does one determine if a flash or flame is capable of igniting a sheet of paper?						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
3. 16.7.1.4(c) - disruption of the package is not clear. In the example of an electric detonator in 16.7.1.5 the reaction caused the box to break open and release some of the assemblies, yet that product was classified as 1.4S. Based on 16.7.1.4(c) the results seem to clearly eliminate the product from 1.4S. The example is in conflict with the stated criteria.						
The criteria should clarify that disruption of the package causing projection of the non-explosive contents or the packaging, in and of itself does not constitute failure i.e. evidence of a hazardous effect, unless such projection truly presents a hazard. For example, it should be clarified that the projection of light-weight materials, such as pieces of fiberboard or cushioning, in a manner unlikely to cause injury does not constitute a hazard. The competent authority should be required to take into account the effect of the initiator when assessing the results of the test if they are significant, especially if it is expected to produce hazardous effects outside the package.						
10. Use the space below to provide any other comments about the 6(d) test.						
The only seriously bad thing about this test was the way the CAs applied it without adequate thought to the consequences.						
Good examples would be nice with the 6(a), (b), and (c) tests. Similar to the kind given on the 6(d).						
I have the following remarks / questions: In all test series: what is mild steel? Is this a specification and do we have the same understanding about this stell all over the world? Tolerances need not be specified, see also international agreements about this. Test series 6(b): “surrounded by 1 m of confining material.” At what distance to the munitions and what material shall be used???						
Test series 6(c): what fuel shall be used, what is the minimum temperature to de obtained, if nothing happens within 30 minutes, how long do we have to continue the test, who decides this??? At what distance are the witness screens??? What is with Hazard Division 1.3: any fiery projection??? With the definition of HD 1.4 from MP20-21 (national Netherlands regulation (EdJ)) and AATSP-1 (NATO publication (EdJ)) I have a different felling then the reactions described.						
I am missing test series 6(e) for some UN numbers (pyrotechnic articles) for determining HD 1.4S or does this merge with 6(d)??						
Are we going to change AASTP-3???? Or do we refer in STANAG 4123 to the orange book??						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
It is completely unclear and seemingly illogical why there are now two sets of criteria for 1.4S, with one of those sets only applying to a handful of articles based on which UN number they are assigned. The tendency now might be to shy away from using those unlucky "special" UN numbers when another suits the purpose as well. Was the driver of the relatively new 6d test concern about 1.4S articles being allowed on passenger aircraft? Why not be equally stringent in assigning 1.4S to all articles?... Only one set of criteria, regardless of UN number, for 1.4S would make much more sense. And the preference would be to do unconfined 6d testing over confined 6a trials, because in both you should be investigating the reactions of smaller less-violent articles (not 1.1), and the benefit provided by no confinement is very helpful in viewing actual effects external to the packaging.						
Inclusion for group S requires that all effects remain confined within the package, if required effects are demonstrated in 6(a), why can't this test be waived? both test seem to be testing the same theory. Special provision 347, how can SP347 apply to 6(d) if SP347 states to use results from test 6(d)? When developed, this seemed to be a simple test to apply. In reality, its application is not straightforward. Products that were unquestionably classified as 1.4S unexpectedly fail the test. Consideration should also be give to a similar test to better determine products' suitability for assignment to 1.4D. In general, 1.4D products should not produce an air blast not greater that the equivalent of the detonation of [100±??] g of PETN in free air. This test is applied only to a select, small number of products. It should apply to all products under consideration for 1.4S. 2. Consideration should be given to broadening this test to determine the hazardous effects outside the package arising from accidental ignition or initiation of the contents, with testing being done by a method that simulates actual accident scenarios. This should replace determination of mass detonation as a criteria for Test Series 6. Whether or not a product mass detonates does not necessarily relate to the hazard level, and can be misleading. For example, two large devices packaged together may not mass detonate, yet the hazard level of one initiating might be severe. Alternately, some small devices may mass detonate yet pose only a very small hazard level. The current system does not distinguish between them.						

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
It is suggested to add another example: 50 shaped charges, cone filled with inert material, placed facing each other in special box out of wood and wire frame, ignition with a detonator, result: no denting of witness plate, reaction of only the ignited item, package torn open, charges remain in package, packaging partly ejected in vicinity; 1.4S						
16.2.2: Test types 6(a), 6(b), 6(c), 6(d) are performed in alphabetical order Recommendation - test types 6(a), 6(b), 6(c), 6(d) are started by test 6(d) - in the case the test 6(d) comply with requirements the test 6(a), 6(b), 6(c) are performed in alphabetical order - this procedure should by used for explosives (detonators) classified 1.4S which follow special regulation No. 347 Reason of changed procedure - this proposed procedure could safe cost for test series 6 in the case the last test 6(d) performed in alphabetical order does not comply with requirements						
• The requirement for the 6(a) and 6(b) tests should be removed if the explosive passes the 6(d) test. • If a given article in a given packaging configuration passes the 6(d) test, then an article with a lesser degree of hazard will as well. Provided that such a lesser hazard can be demonstrated clearly and beyond reasonable doubt, then the article with a lesser degree of hazard should be approved on that basis. • If a given article in a given packaging configuration produces no hazardous effects outside the article itself, inner packaging, group of inner packagings, or intermediate packaging, etc. then it cannot produce them outside the outer packaging either. Provided that this can be demonstrated clearly and beyond reasonable doubt, then the article should be deemed to pass the entire test without the need to involve what may be large numbers of other articles, and the adherent cost/waste. In such instances where it is technically and scientifically justifiable, we feel it is sensible to allow the articles in the packagings to be replaced by a non-hazardous material or sensors/data recording equipment, etc., except where this would invalidate the results of the test. We suggest this again with a view toward preventing large numbers of articles irrelevant to the results of the test from needlessly being rendered unsuitable for any other use.						

UN Test Series 6 Review
Survey Results
TS 6(d)

Survey Question and Replies	Replies					Comments
	Yes		No			
	#	%	#	%	Total	
A possible example would be in a case where previous testing of similar articles or the article itself, its inner packaging, group of inner packagings, or intermediate packaging, etc. had indicated that the hazardous effects were restricted to a given area of the packaging but the other unaffected inner packagings were necessary to maintain the overall configuration during testing. • If a given article in a given packaging configuration or the article itself, its inner packaging, group of inner packagings, or intermediate packaging, etc. can be shown by testing using valid methods other than those specified in the procedure for the 6(d) test which are accepted as being equally effective and equivalent to demonstrate that there will be no hazardous effects outside the package in the event of an accidental initiation or ignition of its contents, then we suggest consideration be given to an approval being granted on the basis of such methods. These might include numerical modeling, computer simulation, measurement of hazardous effects via instrumentation, statistical means, etc. of quantifying the acceptable/equivalent level of risk. With such a provision, technological advances could be allowed for, electively at first, and possibly a greater degree of certainty and statistical validity than the existing procedure could eventually be achieved, and thus an even higher level of safety. • If a given article in a given packaging configuration passes the 6(d) test, we feel it is logical that reasonable variations that differ only in minor respects from the tested type may be used without further testing, provided an equivalent level of performance and safety is maintained. If there is in fact substantive doubt that an equivalent level of performance and safety is being maintained, then the submission of relevant and scientifically supportable proof possibly including additional testing of the article itself, inner packaging, group of inner packagings, or intermediate packaging, etc. should be allowed in lieu of requiring a complete re-test at an authorized laboratory or testing facility. Please see additional comments and explanation in our attached letter.						

Annex 3

Specifications of Detonators used as Alternatives to the UN Standard Detonator

Detonators reported to be used by test agencies in place of UN "Standard Detonator"
specified in Appendix 1 of the Manual of Tests and Criteria

Country	Test Agency	Manufacturer	Detonator	Total Load (mg)	Output		Other		Notes
					mg	Expl.	mg	Expl.	
				600	*400*	*PETN @440 bar*	*200*	*PETN @20 bar*	European
				642	*447*	*PETN @280 bar*	*195*	*LA*	US #8
Canada	NRCan	Dyno	Dyno DiPed	950	875	PETN	75	LA	
Canada	NRCan	Orica	Exel SHD	0					Shock tube
USA	EMERTC	Teledyne RISI	RP-81	530	450	RDX	80	PETN	EBW
Australia	Australian Munitions	Any		NEQ+					Spec Det not available in Australia
USA	Explosives Examiners	Petro-Explo	RJ-333:EBW or A4-139	530	350	RDX	180	PETN	Part number uncertain
Netherlands	TNO	Orica	Dynadet-C2-0ms		unk		unk		
USA	APT	Teledyne RISI	RP-80	203	123	RDX	80	PETN	EBW